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Structural Steel

SPACE forbade last week comment on the review of the field of steel structural engineering, so ably handled by Professor Marburg. The average engineer who does not follow steelwork closely is under the impression that that branch of civil engineering is so thoroughly standardized that little new is to be expected. With the rapid development of reinforced concrete, sewage treatment methods, hydroelectric practice and other specialties he has overlooked the important advances in the structural-steel line. To such Professor Marburg's review should be an inspiration. It shows that this branch of the field is by no means dormant, that its problems are large, its developments important and—by interference—that those who are setting the pace in this specialty are engineers of large mould. It should be an inspiration, too, to the younger men who are in training to fit themselves for the positions now occupied by those whose places it will be hard to fill.

Cushionless Wood Block Pavement

WOOD-BLOCK pavements in Europe have in the past been laid without cushion layers, the blocks resting directly on the smoothly floated top of the concrete base. The use of this method has been urged in this country and on page 52 is an account of a pavement of this type laid on a busy street in Chicago. Its use has proved satisfactory abroad and the experience with it under American conditions will be watched closely. There is no reason to believe that it will not give equally satisfactory service here. The apparent advantage lies in dispensing with the sand layer, which, in a non-waterproof pavement, is apt to be washed away, allowing the blocks to settle unevenly and ruining the pavement. Wood-block pavement practice abroad could also be followed with good advantage here in the effort, made by dipping the blocks into hot tar, to secure a water-tight surface. This process is completed by using a tar coat, squeeged into the joints. The pavement referred to is not without interest also, in that it follows an experimental section of "bridge floor," composed of narrow strips bolted together and laid on edge. This type has decided advantages in laying on a busy street, but the Chicago experience indicates its unsuitableness where traffic is heavy.

Principles of Channel Maintenance

IT is generally conceded that no engineer in this country has had a longer and more varied experience in the control of rivers than Elmer L. Corthell. Anything he may have to say on a subject which he has been studying for 46 years is well worth hearing. At the recent meeting of the American Association for the Advancement of Science Dr. Corthell summed up the principles of channel maintenance at the mouths of rivers, and his address is printed in abstract on page 42. The basic idea of river regulation, Dr. Corthell believes, is epitomized in James B. Eads' reply to a Senate committee which asked him how he proposed to prevent the shoaling of the channels at the mouth of the Mississippi River by the fan-like expansion of the water. Mr. Eads replied, "I propose to shut the fan." In planning for channel maintenance at the mouths of rivers, permanent parallel works to contract the stream and increase its velocity offer the logical solution of the problem. Parallel jetties make the river do its own work of channel deepening and maintenance, and Dr. Corthell has found that dredging should be used only as an auxiliary process. His history of the Mississippi River regulation makes entertaining and instructive reading and his comparison of the results at the south pass, where his own ideas were carried out, and at the southwest pass where the principles he outlines were not adhered to, is convincing evidence of the soundness of the policy which he enunciated in the early seventies.

Waterwheel Characteristics

THE interpretation of test reports from the Holyoke testing flume and the use of diagrams for this purpose were set forth recently in the Engineering Record in two articles by Prof. S. J. Zowski. In those articles waterwheel models were compared and recent progress in design shown, but no data on the methods of plotting the diagrams were given. In the article on page 45, George H. Bancroft describes these methods and shows how the diameter or power and speed of larger wheels can be figured from the test-report data on the model runner, when the new head and either the required diameter or power is known. A well-chosen example shows how such a problem is approached and solved. A table gives the power of a 30-in. model under 1-ft. head, when run at three different speeds and various efficiencies. The table also gives the power of a 60-in. wheel, built after the same design as the model, for heads of 1, 22, 27 and 32 ft. when run at the same speeds and efficiencies as the model. The heads of 22, 27 and 32 ft. were chosen because 22 ft. is the given minimum head on the assumed plant, 27 the average normal and 32 the maximum head. The article is a supplement to those published previously and will be helpful to many engineers who are called upon to check the statements of the waterwheel builder.

An Engineer as City Adviser

TWO thoughts are suggested by the news that Charles M. Spofford, Hayward professor and head of the department of civil and sanitary engineering at the Massachusetts Institute of Technology, has been named adviser for the city of Cambridge. The first concerns the opportunities for cities to benefit by the special training of their own residents. Any town which is the seat of a great institute of learning—particularly if that institution be a technical college—is in a position to profit by the experience of certain members of the faculty. It is not to be inferred from this that any city should seek to do away with the services of a consulting engineer, but in deciding upon broad questions of policy the advice of citizens who are specially qualified to express opinions will be of inestimable value to any administration which is in office to promote the best interests of the community and not for personal gain. The other thought occasioned by Professor Spofford's appointment is one of gratification that a technically trained man has been selected to take an active part in public affairs. People are just beginning to realize that the engineer is responsible for the physical development of the community and consequently is an indispensable member of certain municipal executive bodies. It is interesting to note that Professor Spofford, a technical man, was selected by the Mayor of Cambridge as a member of a board to give advice on some vexed matters of taxation.

Ottawa's Water Case Again

THE attempt of the Provincial Board of Health to foist upon the city of Ottawa the $8,000,000 Thirty-one Mile Lake water supply, in place of the $2,000,000 Ottawa River project involving mechanical filters, has been thwarted by Justice Middleton, who, in granting the city a mandamus against the order of the board last week, declared that the board had clearly gone beyond its powers when it assumed to criticise and reject the engineers' report upon the source of supply. It will be recalled that the board, composed of men without engineering training, directed the city to prepare detailed plans and specifications for the filtered river-water project, as outlined by Allen Hazen, and then rejected them on untenable technical grounds, substituting its own pet scheme, involving an increased expense of $6,000,000. This brings up the whole question of the jurisdiction of such bodies. Obviously it is desirable for a central authority, as is the case in many of the States of this country, to exercise some supervision over the plans for public works such as sewerage and water-supply systems. It seems to this journal that if the board prevents nuisances or menaces to public health it has fulfilled its functions. It is chiefly concerned with results, and the question of how they are to be obtained is clearly one for local decision. There is no question but that an adequate and safe water supply for Ottawa can be secured from the Ottawa River. This being the case, it is for the city and not the board of health to decide whether it wants water from this or from some other source. No one will deny the good work which boards of health are doing, but where they become meddlesome in details their power should be curbed.

Alien Labor Law

BY declaring unconstitutional the clause in the New York subway contracts which prohibits the employment of alien labor on State work, the Appellate Division has lessened the fear that construction involving many millions of dollars would be tied up by the labor unions. The case will go to the Court of Appeals, and not until its decision is rendered will the matter be finally settled. The situation was so grave that the case caused widespread interest among engineers and contractors, not alone in New York but in other States.

The law, as it is now, had been reregarded as a dead letter for years past, and contractors had been submitting bids based upon the lower prices of foreign labor as compared with that of citizens. Obviously if it had become necessary to enforce the letter of the law after the contracts had been signed, many firms would have forfeited their contracts and faced serious financial embarrassment. All of the justices of the Appellate Division concurred in the decision, which emphasizes the point made in the editorial columns of this journal, Nov. 28—that it would be incompetent for the Legislature to impose upon private persons or corporations not engaged in performing public works such restrictions as are attempted to be imposed upon the city of New York as a municipal corporation. Another matter commented on is New York's policy toward immigrants. The city has always offered to aliens equal participation in all the opportunities and advantages of its business life. The alien-labor law is in direct opposition to this spirit.

An interesting feature of the court's decision is the opinion that the subway is a business enterprise and does not come within the scope of "public works." Justice Ingraham says, "The city is not building these subways for the benefit of the people of the State, but for the benefit of the municipal corporation. It owns such subways and they are operated not as public works but as the private property of the city. Therefore, the provision of this section of the labor law did not apply to the city of New York when building a subway or railroad as a business enterprise of the city." The decision of the Court of Appeals will be awaited with anxiety by engineers and contractors, for on it depends not only the completion of much work already under way, but a material advance in the cost of work should the law be allowed to stand. Aside from these important phases, the social injustice of the present statute cannot but be of interest to every man who believes in fair play and who resents the arrogance of the interests responsible for the legislation.

Abolish the Commission!

WHEN the Pennsylvania Public Utility Commission failed to act in accordance with the demands of Philadelphia commuters that passenger fare increases should be forbidden, clamor arose in certain quarters that the commission should be abolished if it did not act, and act promptly, as the commuters thought it should. The incident is illuminating. As long as commissions decide cases against the railroads they are approved; if, however, they find in favor of the carriers, why, then we might as well abolish commissions. Unexpressed in most cases is the feeling that public utility commissions are bludgeons with which to belabor public-service corporations. If this feeling is allowed to prevail, and if commissions act in accordance with it, the commissions will in fact be abolished by their own fatuity. They are either to be guided by justice or they have no excuse for existence. To demand their "recall" whenever they do not decide in accordance with the public opinion of the moment, is the same thing as to demand that the Supreme Court be abolished if it does not dissolve the steel corporation. The Pennsylvania commission is of course in no danger, but it is a sad commentary upon democracy that some of its more noisy disciples should be able to get a hearing for so outrageous a proposition as the abolition of a public body because it is doing its duty instead of taking money out of railroad treasuries and putting it into the commuters' pockets.

In this connection it is not out of place to say that the Federal Trade Commission—now about to be set in motion—will, like similar institutions, ultimately be judged by the measure of justice and wisdom. If it becomes merely meddlesome, if it affords a haven for cranks and radicals and those who are seeking their own advantage by attacking others, it cannot endure—that is, it cannot unless a majority of us are afflicted by the mental disease that has led Philadelphia commuters to attack a commission because it presumed to render a decision that is in part favorable to the railroads.

Sewage Disinfection by Steam

THE report which the International Joint Commission made public some time ago laid stress upon a form of water pollution with which the majority of sanitary engineers are not called upon to deal. It was pointed out that vessels using the Great Lakes and discharging raw sewage therein are a serious menace to cities which draw their supplies from these waters. From the tone of the report it was fair to assume that some measures would be prescribed for abating this menace to public health, and in the latest weekly bulletins of the U. S. Public Health Service a device for disinfection with steam, suggested by Prof. Earle B. Phelps and designed by Leslie C. Frank, is described. It is applicable to both vessels and railway coaches. The problem of treating ship sewage, obviously, must be governed by considerations entirely different from those which control the design of works on land. In the first place any treatment device on a ship or railway train must occupy a very small space—large tanks, filters and other methods of treatment usually employed for towns and cities being thus eliminated at the start. Then, too, sewage from ships is of vastly greater strength than ordinary municipal sewage and its production is intermittent, as against a more or less uniform flow on land. Clearly, the sanitary engineers of the U. S. Public Health service could not look to municipal practice to aid them in the solution of the problem.

The compact steam disinfection device described on page 43 has been proved by tests at the Hygienic Laboratory in Washington to be efficient in destroying pathogenic bacteria in fecal matter. Its first cost is estimated at from $15 to $20, and preliminary studies of operation indicate that with steam as a heating agent disinfection on lake steamers will cost 5 cents per day for each closet, and on railway trains 1½ cents per day for each coach. Much interest in the development of this device was displayed by a number of carriers, giving ground for the belief that its introduction will not be as difficult as might have been expected. On the Great Lakes the Government can probably enforce installation of some adequate sewage treatment device. On the railways the States undoubtedly are in a position to enforce proper provision against the pollution of lakes and water courses.

Publicity for Committee Work

TECHNICAL committee work is the most important of the activities of many engineering societies. Some, in fact, exist for no other purpose than to bring together specialists willing to give their experience in the formulation of standards of practice, the writing of specifications, and the direction of investigative work. Yet the attitude of the societies in this committee work is not always such as to profit by the experience of the rank and file of their membership.

The committee, presumably, is composed of the most able men in the particular specialty. They are privileged to call for assistance and advice upon any persons they desire, be they members of the society or not. Only insofar as they seek assistance or discuss committee work with their personal friends, are the committee's activities known outside its own very limited membership. Once a year, it is true, a progress report may give sufficient detail as to what has been done to invite constructive criticism from the membership at large, but seldom is there a sufficient forecast as to future lines of investigation to stimulate inquiry. In fact, the general conduct of committee work in the past has been such as to result in a jealous guarding of all information as to the committee's program. There seems to be a fear that the efforts will be frustrated if the plans become generally known.

This attitude, in the judgment of the Engineering Record, is detrimental not only to the work of the committee itself, but also to the society as a whole. The committee does not get information and assistance that might be invaluable, while the society fails to reap the advantages in increased loyalty and interest which come from a more intimate knowledge of its work.

Apparently, publicity for committee work is the solution. The American Railway Engineering Association publishes in its bulletin each year the program of each committee. It might well follow up such publication with news, as warranted, of the progress made or of particularly interesting steps taken. To take a specific example from the work of another society, the committee on stresses in railroad track of the American Society of Civil Engineers has experimented with quite a number of machines for measuring stresses in track, yet few members know even this much about its work, while even a smaller number know how far the studies have gone or whether a satisfactory machine has been found. In the American Society for Testing Materials, the committee on concrete aggregates has been split up into subcommittees, each charged with the gathering of data on a very interesting problem, yet few engineers know enough about the work to offer data in their possession which might be pertinent. It may be contended that the committees would receive much useless material and be burdened by additional and unprofitable work. This objection, however, can hardly be entertained seriously, for a secretary skilled in letter writing can easily handle these matters.

As for the effect of publicity for committee work on the society as a whole, the Engineering Record believes that it can not be other than favorable. It would increase the interest of members and tend to allay the criticism heard that some societies contribute but little to their members. The participation in committee work would be greater, for every member would feel, as now he does not, that his assistance would be welcomed.

To what extent information should be given out must rest with the committee. No one would advocate the publication of immature preliminary conclusions, nor the publication of data not verified and digested. A safe start can be made by publishing the programs and news of especially important researches or tests undertaken. Experience and the good judgment of the committee members will indicate what thereafter is advisable.

The Engineering Record holds this to be a subject of the greatest importance to engineering societies and believes that once it is brought home strongly to officers and members the present policy of secrecy will give way to one of publicity. At heart, no one wants to hedge about committee work in this way; it is a custom that has grown up and the necessity for its abandonment has not been heretofore clearly appreciated.

Further Observations of the Effect of the Edison Fire

SINCE the report in the Engineering Record of Dec. 19, of the fire which swept the Edison factory at West Orange, N. J., on Dec. 9, opportunity has been afforded for a careful study of the present condition of the concrete structures. There has been no reason to change the statement then made that the concrete buildings, in general, were in good condition, and close examination into details has confirmed the original surmises.

It was noted in the report of Dec. 19 that the more destructive effect of the fire on the columns than on the beams was decidedly noticeable, and in the editorial in the same issue question was raised as to the part played by the untied rods in the column failures. It is apparent from thorough examination that to the lack of ties on the rods the destructive effects were most largely due. As was shown in photographs accompanying the article, the expansion of the rods where the fire had been very hot had forced off the corners. This action diminished the column section to such an extent that the reduced shaft was overstressed and in some instances failed. In many cases where the corners did not come off, there are cracks lengthwise on either side of the corners, indicating that the expansion of the rods had had no less serious results.

The question naturally occurs as to the adequacy of the protecting layer of concrete over the rods. While in places this may have been inadequate, in general it was equal to the 2 in. considered satisfactory. This would point to an especially hot fire, that is, one considerably exceeding the usual testing temperature of 1700 deg. Fahr.

As to the behavior of columns with rods properly tied or enclosed in hooping, this fire does not furnish competent evidence, for while in Building 7, the tool department, hooped columns were used, they were not subjected to the severe heat responsible for the column failures elsewhere. They came through the fire well, and, while arguing from the effects of the untied rods, one is warranted in presuming that the hooped columns would have proved far more satisfactory, definite proof is lacking. It is certain, however, that in a normal fire—of about the customary test temperature—the hooped column can be relied on.

It is fully apparent, however, that despite the niceties of argument which may be pursued as a result of the experience at West Orange, the provision of a proper factor of safety points to the use of the round hooped column, for even were rods tied at intervals of about 12 in. there is probability that some of the corners would have been forced off, even though the column shafts would have remained intact. The round column would seem to have an additional advantage in a fire in that the weak spots presented by the corners of the square columns are eliminated.

As to the floor system, the behavior in Building 24 is particularly interesting. As stated in the article published in the issue of Dec. 19, the floor slab was cast separately from the structural frame. At possibly over half of the beams and girders there is a crack between the underside of the floor slab and the structural member. It is reasonably certain that had the construction been monolithic this line of weakness would not have developed and that the advantages inherent in a thoroughly monolithic structure would have been reaped. Certainly the expensive reconstruction of beams and girders, referred to on page 40 of this issue, would not have been necessary had the floors been tied in to beams and girders.

Close observation indicates, too, that adequate provision was not made for developing the full strength of the tension members. The moment reinforcement, consisting of heavy square twisted bars, is placed too close to develop their full strength. In places as many as six square twisted bars of about 1-sq. in. cross-sectional area have been found in beams and girders 8 in. in width. On account of the type of construction used, this reinforcement, when carried up to take care of negative moments at columns, has not been brought into the slab but carried up only to its under side.

The shear reinforcement, in the shape of stirrups, was apparently inadequate, and what stirrups were used were simply lapped under the layers of beam rods. Long diagonal shear cracks in cases showed the insufficiency of this reinforcement.

As to one feature discussed in the article of Dec. 19, the Engineering Record's later observations indicate that its first statement was in error. It was stated that the plaster block did not withstand the conflagration. The partitions in question were the usual gypsum blocks, and later examination discloses that while in certain cases they failed they are in general in good condition. Where failures occurred some other agent beside fire was evidently brought into play. Very likely the fire streams were a factor; in one instance, at least, the blocks were water soaked.

It will not be amiss, finally, to revert again to the primary responsibility for the fire—the lack of automatic sprinklers, fire walls and adequate protection of window and door openings. It is interesting to know that in the reconstruction steel sash set with wire glass is being used and that the advisability of installing automatic sprinklers in all of the concrete buildings will shortly be taken up. Only by taking these precautions can buildings unburnable so far as their frames are concerned be made truly fireproof and afford the protection to contents which the word fireproof conveys to the average mind.

The Underground Survey of Cincinnati

Methods and Costs of Locating and Mapping Subsurface Structures Preliminary to Installing New Sewerage System

By O. E. CARR
Formerly Engineer in Charge of Underground Survey, Cincinnati

EARLY in 1912 the council of Cincinnati set aside $125,000 for the purpose of sewerage investigations, designs and plans. In view of the evident need of the expenditure of a vast sum of money for new and relief, as well as for intercepting sewers, it was decided to make a thorough investigation of existing conditions so that future construction could be made intelligently and in accordance with a comprehensive plan. To this end it was decided to make a complete underground survey of the whole city which, together with the topographic survey undertaken at the same time, would give all the information needed for detailed studies of any section of the city. The existing records were wholly inadequate for the purpose. Some of the old plans, for example, did not show the sizes or grades of the sewers.

Field Work

The primary purpose of the field work was to secure all necessary information regarding size, location, depth, grade and condition of the existing sewers. At the same time, however, car tracks, curb lines and all surface indications of subsurface structures were located by the field parties as the additional expense incurred thereby was slight compared with the increased value of the permanent records.

The first field party began work on April 27, 1912. The initial plans required the field party to locate objects in the street with reference to the curb lines, to obtain distances between sewer manholes, and to secure the size of sewers and elevations of invert at each manhole or outlet. On account of the uncertainty attached to the property plats of Cincinnati it soon became apparent that connected plats could not be made from field notes taken in this manner. The field methods, therefore, were at once changed so as to make the field work complete in itself and entirely independent of any existing records.

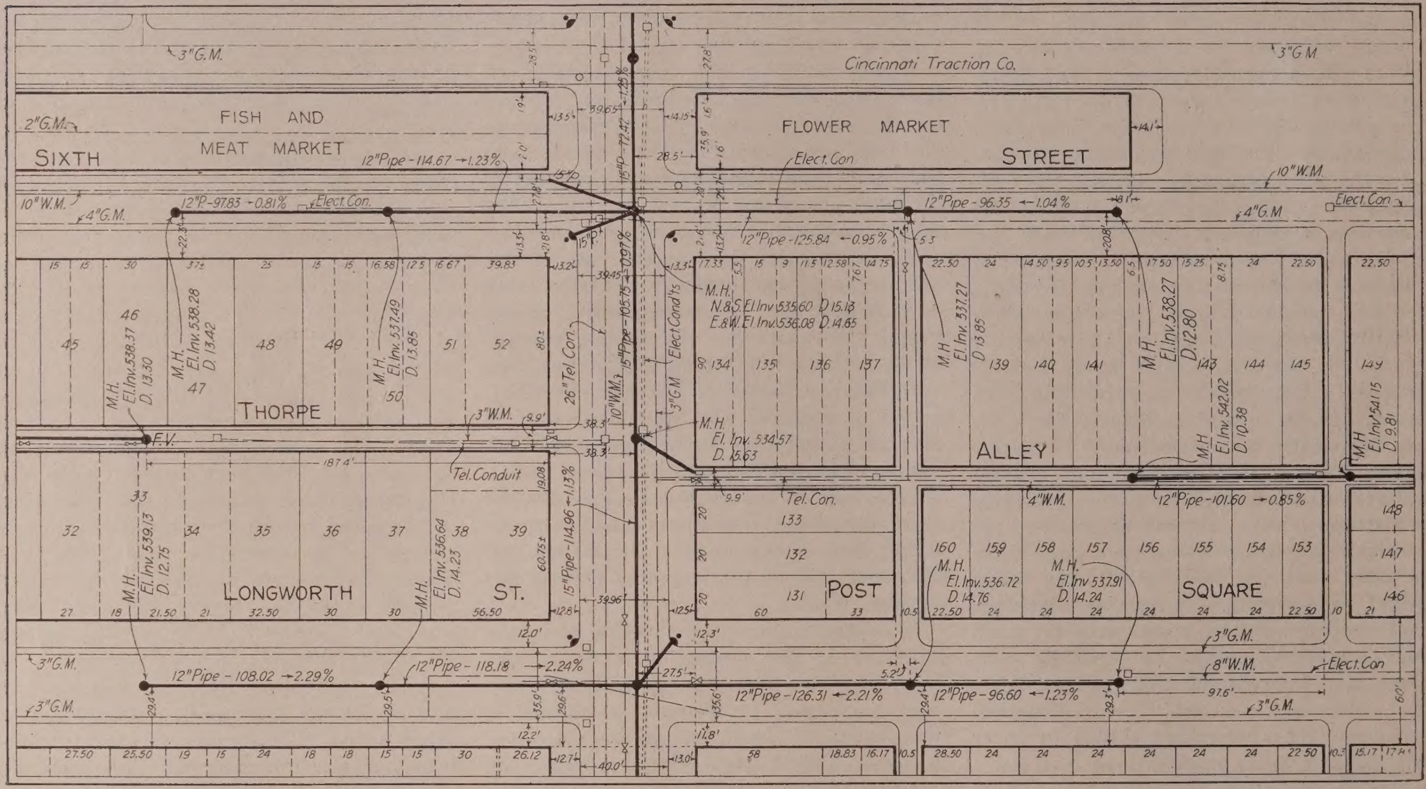
Each field party was given an assignment of about one week's work at one time and was expected to run a closed traverse around the assignment and traverses on all interior streets, closing on the primary traverse. From these traverse points all objects in the street were located by the angle and distance method. The telescope of the transit was constantly kept in the direct position and all angles were turned off in a clockwise direction, always checking finally on the backsight. Wherever possible the sewer manholes were used as traverse points, but in case of excessive interference of traffic the traverse points were placed on the curb line. The distance along the sewer between manholes as well as the distance between traverse points was measured. Each sewer manhole was located with reference to the curb line and the distance between curbs was obtained at each manhole. Traverse lines were run over all sewer lines, whether on streets or not, and on all improved streets whether sewered or not. Levels were run over the assignment, an elevation being obtained on the downstream side of each manhole top and of each sewer outlet. The elevations of flow lines of sewers entering manholes were determined from these elevations on manhole covers. Manholes were further examined to determine the sizes of the sewers entering. If the sewers were in need of cleaning or the manhole in need of repair, the matter was brought to the attention of the proper department.

Loose-Leaf Notes

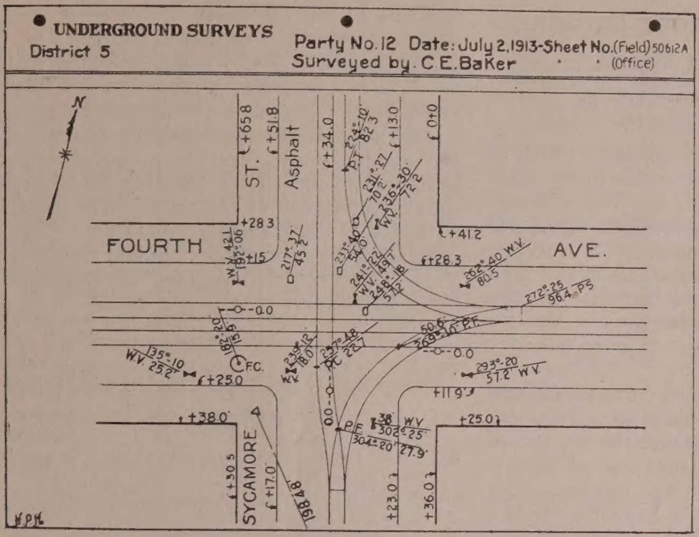
All field notes were taken on loose-leaf sheets. When the work was first started the chief of party was furnished with blank sheets, information was recorded in the field, and the sheets were numbered on their return to the office. This method of numbering proved unsatisfactory, for not only was it impossible to cross index properly in the field but frequently a sheet, incomplete in some particular, would be held back by the chief of party, thereby losing its place among contiguous sheets. Experience also demonstrated that time was saved in the field when the field sheets were partially prepared in advance by having street and curb lines drawn and the proper street names inserted. Consequently, after November, 1912, sheets so prepared were issued. Each field party was given the sheets of one series of numbers. For instance, the sheets given to party 2 were in the 20,000 series. When the field sheets of an assignment were completed they were returned to the office, levels were checked and sheets were indexed by streets and filed away for use. The loose-leaf system of field sheets proved entirely satisfactory for this work.

A typical field party consisted of four men, chief of party at $90 per month, instrument man at $60 per month and two rodmen at $50 per month.

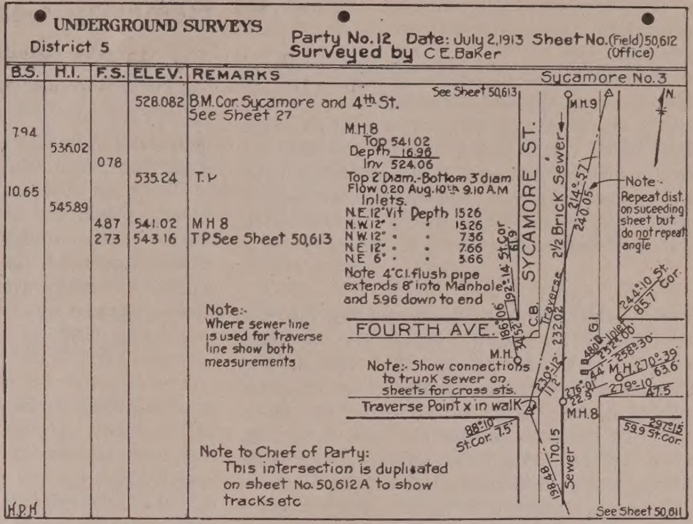
The number of field parties was gradually increased from one on May 1, 1912, to five on Aug. 23, 1912. On Jan. 16, 1913, the sixth party was placed in the field, and in May, 1913, the seventh and eighth. With this force working during the summer the field work was finished, the last party being disbanded on Nov. 22, 1913. During these



PORTION OF TYPICAL PLAN SHOWING KIND OF INFORMATION PLACED ON DRAWINGS FOR UNDERGROUND SURVEY AT CINCINNATI



SPECIAL SHEET USED FOR IMPORTANT INTERSECTIONS


UNDERGROUND SURVEYS
District 5
Party No. 12 Date: July 2, 1913 Sheet No. (Field) 50612 (Office)
Surveyed by C. E. Baker
B.S.
H.I.
F.S.
ELEV.
REMARKS
Sycamore No. 3
528.082 BM. Cor. Sycamore and 4th St. See Sheet 27
7.94
536.02
0.78
535.24 T.P.
10.65
545.89
4.87 541.02 M.H. 8
2.73 543.16 T.P. See Sheet 50,613
Note:- Where sewer line is used for traverse line show both measurements
Note:- Show connections to trunk sewer on sheets for cross sts.
Traverse Point x in walk
Note to Chief of Party: This intersection is duplicated on sheet No. 50,612 A to show tracks etc
Note - Repeat dist. on suceeding sheet but do not repeat angle
FOURTH AVE.
SYCAMORE ST.
2½ Brick Sewer
See Sheet 50,611

TYPICAL FIELD SHEET FOR UNDERGROUND SURVEYS

nineteen months complete information was obtained concerning 496 mi. of sewers, together with data pertaining to the streets of the city. The total number of miles of sewers in the city as determined from annual reports of sewers built by the city, together with the total miles credited to the various annexed territories, is approximately 100 mi. less than the mileage determined by the underground survey. This large difference is made up mainly of sewers built by private parties in subdivision improvement which were at a later time dedicated to the city, together with some sewers built with street improvements but which were never reported in the regular way. This survey developed the fact that in several places sewers were laid with the outlet higher than the inlet. As a result certain manholes were partly full of sewage at all times. Other cases were found where a 24-in. pipe drained into an 18-in. pipe with no corresponding change in grade. Grades as stated in existing records were found to differ so materially from grades as determined by the survey that all recorded grades became questionable.

SEWER RECORD PLANS

The primary purpose of the sewer record plans is to show correctly all information pertaining to the sewers—their sizes, grades, locations, inlets and branches. They cover all of the improved parts of the city, are drawn to scale and record the lot number, street frontages, street widths, roadway widths, curb lines, car tracks and all underground structures. They show, therefore, by inspection, the logical place for laying any new pipes or conduits. These record plans are 23 by 32 in. within the borders. There is a binding edge of 1½ in. on the left hand end of each sheet. The lower business portion of the city is platted on a scale of 40 ft. to the inch; all other portions to a scale of 50 ft. to the inch. It is estimated that these plans will number slightly over 700. The plans for this work include the binding of white cloth prints made from these tracings into loose leaf books. These white prints are made by a lithographic process. They are very clear and distinct yet they lend themselves to erasures and corrections more readily than tracings. Sheets of contiguous territory are to be bound together. They will be numbered and cross numbered, and a key map will be given on the first page of each volume. The books will be indexed on a wall map.

An idea of the extent of this work is given by the preliminaries necessary for it. They include:

1. Tracings of the entire city, made from plats in the county auditor's office.
2. Complete copies of plats in the office of the gas company, showing sizes of mains and the location of them in the streets.
3. Complete tracings of all water information; these tracings are made from the records of the water works and show sizes and locations of water mains in the streets.
4. Complete information from the telephone company regarding size and location of their conduits.

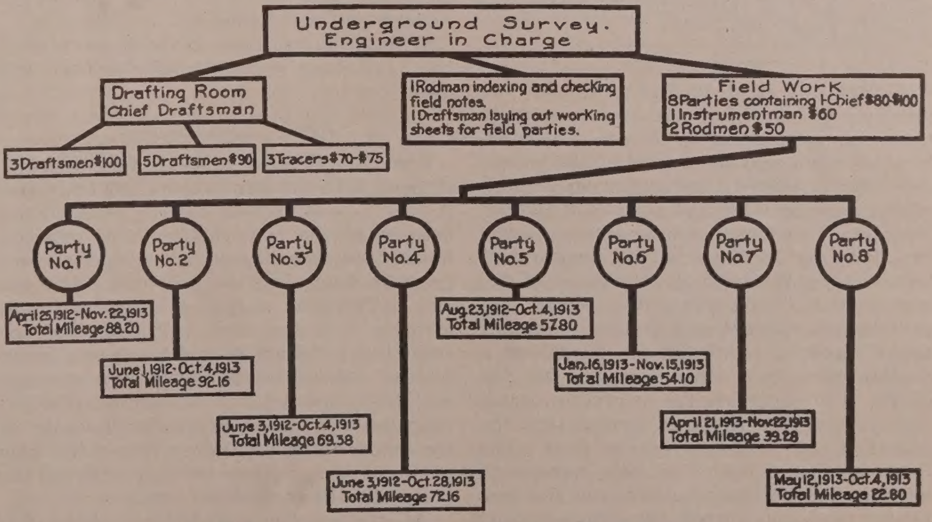
The plats represent all surface lines by full lines and all subsurface lines by broken lines, except the sewers which are shown by heavy lines.

PLATTING FIELD NOTES

The method of procedure for platting the field notes was as follows: First, the controlling traverse was figured. Then the traverse was platted by co-ordinates on detail paper. R. L. Gurden's "Traverse Tables" were used. The latitudes and departures were checked either by means of Gurden's tables or by the use of the slide rule. The traverse of cross streets was usually platted by means of the scale and protractor. An interior traverse was figured only when it failed to close by this method. Platting by co-ordinates proved to be a time saver and also a source of satisfaction to the detailer, as it gave him some definite and fixed points on which to base his details.

The platting of the traverse was followed by the location of curb lines, street lines, and all other information obtained in the field such as distance between sewer manholes, size of sewer, depth and elevation of invert at manholes, the location of inlets, valves, other manholes, and car tracks. The lot numbers and frontages, together with property lines were then shown as taken from the auditor's plats. In case of disagreement the recorded plats as well as the deeds were examined. In no event could any existing record change field information as platted from a closed traverse. Existing plats were frequently proved to be in error. The water sheets were then examined, the size and location of water mains obtained and locations checked against locations of water valves as previously platted from field notes.

The gas sheets were then examined in order to obtain the size and location of existing gas mains. There was no check from the field on this information. The location and width of telephone conduits had been obtained from the company. This was now given, together with the location of manholes as taken from the field notes. The


Underground Survey. Engineer in Charge
Drafting Room Chief Draftsman
3 Draftsmen $100
5 Draftsmen $90
3 Tracers $70-$75
1 Rodman indexing and checking field notes.
1 Draftsman laying out working sheets for field parties.
Field Work
8 Parties containing 1-Chief $80-$100
1 Instrumentman $60
2 Rodmen $50
Party No. 1
Party No. 2
Party No. 3
Party No. 4
Party No. 5
Party No. 6
Party No. 7
Party No. 8
April 25, 1912 - Nov. 22, 1913 Total Mileage 88.20
June 1, 1912 - Oct. 4, 1913 Total Mileage 92.16
June 3, 1912 - Oct. 4, 1913 Total Mileage 69.38
June 3, 1912 - Oct. 28, 1913 Total Mileage 72.16
Aug. 23, 1912 - Oct. 4, 1913 Total Mileage 57.80
Jan. 16, 1913 - Nov. 15, 1913 Total Mileage 54.10
April 21, 1913 - Nov. 22, 1913 Total Mileage 39.28
May 12, 1913 - Oct. 4, 1913 Total Mileage 22.80

ORGANIZATION OF UNDERGROUND SURVEY, 1913 grades of the sewers were then figured, after which the completed detail was ready for tracing.

The operation of checking was nearly as laborious as that of detailing, since everything except the platting of closed traverse had to be checked. A record was kept of the accession number of the drawing with the names of streets covered, linear feet of sewer shown on each street, together with name of detailer, tracer and checker.

COST OF THE WORK

No satisfactory unit for estimating the cost could be found. However, the mile of sewers was used as the unit. This proved unsatisfactory in estimating or comparing the progress of field parties or of office work in sections of the city not improved with sewers, but it was probably as suitable as any other unit would have been.

The accompanying table of cost data shows a considerable decrease in the cost of field work during the season of 1913 which was due to more efficient methods, a better understanding of the work to be done and a reorganization. The considerable increase in cost of drafting in December, 1913, is due mainly, to a large portion of the force working on checking, revision and correction of plans. This fact does not show up in the cost sheet.

PAYROLL COST OF UNDERGROUND SURVEY

1912 To and	Field		Drafting		Combined unit costs for month	Total payroll expenses
	Mileage	Unit cost	Mileage	Unit cost		
incl. Aug.	69.3	$43.39	10.3	$70.51	$113.90	$5,274.29
Sept. ..	34.7	49.49	10.1	74.69	124.17	7,745.55
Oct. ...	17.9	105.42	11.7	75.63	142.71	10,539.55
Nov. ..	12.2	138.59	25.0	45.95	184.54	13,379.01
Dec. ..	14.8	119.28	27.4	39.14	158.42	16,118.39
1913						
Jan. ..	20.3	82.24	27.5	40.06	122.30	18,889.39
Feb. ..	22.5	84.72	25.1	42.80	127.52	21,870.09
March..	20.9	84.38	33.5	36.21	120.59	24,846.72
April ..	26.5	64.62	28.5	36.94	101.56	27,611.98
May ..	43.0	45.17	17.7	50.99	96.16	30,456.78
June ..	47.9	43.37	22.5	47.29	90.66	33,589.15
July ..	49.3	43.88	33.8	37.63	81.51	37,033.27
Aug. ..	44.7	48.87	31.5	36.87	85.74	40,379.11
Sept. ..	47.0	43.77	29.4	38.01	81.78	43,554.09
Oct. ..	17.6	69.52	16.9	65.06	134.58	45,877.26
Nov. ..	7.4	87.47	20.3	58.00	145.47	47,702.13
Dec. ..	0.4	90.45	10.4	114.04	204.49	48,924.28
Total.	496.4	$61.49	384.5	$47.86		$48,924.28

The usefulness of these plans has been clearly demonstrated during the past year. Demands for information contained on them are constantly being made by the water and highway departments, the city solicitor and other officials. The plans should be the first step in the creation of a substantial, important and self-supporting department. The perfecting of this sytem of records can not fail to be of inestimable value to Cincinnati.

A DECISION just handed down by the Supreme Court of Indiana is of concern to the power interests of the State. The court has just dismissed the appeal of the Southern Indiana Power Company from a judgment awarding Washington C. Cook and the Meridian Life Insurance Company $3,000 for damages incident to the overflow of lands by the White River by reason of the construction of the company's power dam at Williams, in Lawrence County. Another appeal from a judgment for $2,600 of a similar type was also dismissed by the court. The parties to the original proceedings to condemn the land agreed that the award of the viewers should be final. The Supreme Court held that this agreement was binding on the company, and the dam having been constructed, the company must pay the amount awarded.

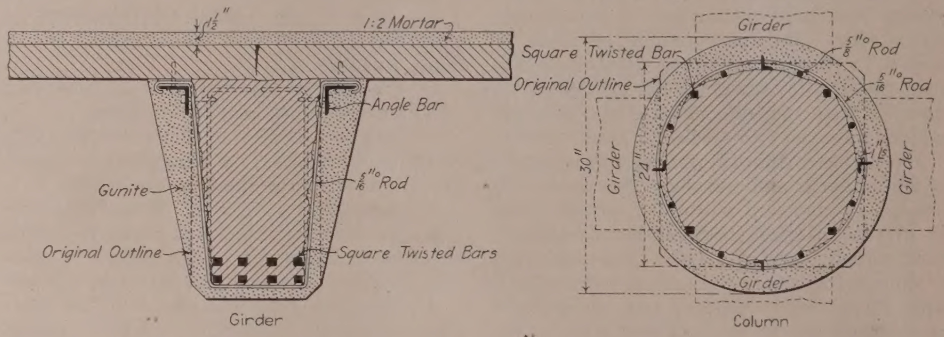
Restoring Concrete Buildings at Edison Plant

Sections of Columns, Beams and Girders Are Being Increased and New Reinforcement Added

IMMEDIATELY following the fire which on Dec. 9 did serious damage to the plant of Thos. A. Edison, Inc., at West Orange, N. J., plans for reconstruction were put under way. The concrete structures, where damaged, are to be restored and work has been started on Building 24, the phonograph record department.

RECONSTRUCTION METHODS

The columns are chipped down to a shape approximately cylindrical, exposing the reinforcement. In cases where the expansion has bent the bars, they are cut off at top and bottom by oxy-acetylene torches. Additional reinforcement is provided in the form of eight ⅝ in. round bars distributed around the circumference and held in place by spiral hooping of 5/16-in. wire, spaced and held by four notched angle bars. A 1:2 cement mortar is then applied, using cylindrical steel forms. The restored column is 30 in. in diameter. The new material can only be deposited up to the underside of the beams with the forms; the remainder will be placed by the cement gun.



SKETCHES SHOWING METHODS PROPOSED FOR RECONSTRUCTING BUILDINGS

Where the column shafts have been sheared the concrete and its reinforcement will be chipped off, leaving short stubs at top and bottom. The necessary shores will be placed before this work is undertaken. An adequate amount of longitudinal reinforcement will be provided, supplemented by spiral hooping, similar to that used for the other columns. Concrete will then be deposited, and in inaccessible places the cement gun will be used.

Where columns have failed so badly that the floor above has deflected, the floor will be jacked up.

BEAMS AND GIRDERS

The beams and girders will also be chipped until the reinforcement is laid bare. As no T-beam action can be counted on, because of the construction joint between floor slabs and beams, an adequate compression flange will be provided below the slab. The new shape of the beams and girders, it is reported, will, therefore, be trapezoidal, the upper part being reinforced by two angle bars to which new stirrups will be connected. A sketch of this arrangement is shown herewith. Because of the impossibility of using forms the new parts of the beams and girders will be placed by the cement gun.

All wooden floors with their cinder fills between nailing strips are being taken up and a 1½-in. wearing surface of 1:2 cement mortar put on and trowelled.

The building is also being provided with steel sash (supplied by the Trussed Concrete Steel Company) set with wire glass.

The consulting engineers in charge of the reconstruction are the Condron Company of Chicago, T. L. Condron being personally in charge of the work. The reconstruction is being done by the Moyer Engineering & Construction Company, of New York City, which designed and erected these buildings.

Progress of Federal Railroad Evaluation

Five New Orders Issued by Interstate Commerce Commission Since Nov. 1, 1914—Inventory of Four Roads Practically Done

IN a review to Dec. 31, 1914, of the Federal railroad evaluation, Thomas W. Hulme, general secretary of the Presidents' Conference Committee, cites certain developments since his last report, which was abstracted in the Engineering Record of Nov. 21, 1914, page 564.

Since Nov. 1, 1914, the Interstate Commerce Commission has adopted five additional orders which recently have been, or are about to be, promulgated. Orders 1 to 4, issued prior to that date, related, it will be recalled, to (1) maps, (2) abandoned property, (3) extensions and additions and betterments, and (4) inventory of materials and supplies. Order 5 provides for an extension of time for filing maps. Order 6 exempts railroad with mileages of less than 100 and earnings of less than $3000 per mile from some of the provisions of the original map order. Orders 7 and 8 provide for the scheduling of lands and equipment respectively, and order 9 fixes rates for the movement of the Government's cars.

There were certain errors in the lists of roads under valuation or on which the work was about to be undertaken, as given in the report of Nov. 2, 1914, abstracted in the Engineering Record of Nov. 21. The Great Northern Railway should have been included with the roads under valuation, and the Winston-Salem Southbound Railway should have been included among those on which the Government intended to start work. The Atlantic Coast Line was erroneously included.

The Government has practically included its inventory of four roads—the Norfolk Southern, the Atlanta, Birmingham & Atlantic, the Texas Midland and the New Orleans, Texas & Mexico—and will probably in a short time complete such work on two others—the Kansas City Southern and the San Pedro, Los Angeles & Salt Lake.

Excavating Plant for Heavy Drainage Work in Arkansas

Type and Dimensions of Machinery Adapted to Channel and Levee Construction in Timbered Alluvium—Floating Dipper Dredge Preferred

THE protection from floods and the local drainage of about 300 sq. mi. of swampy alluvial land, much of it heavily timbered, in drainage district 9, Mississippi County, Arkansas, involved about 14,000,000 yd. of excavation for the construction of channels and levees (see the Engineering Record of Oct. 24, 1914, page 55). The design was influenced by the result of an investigation of the conditions to be encountered, and the most economical and efficient methods of excavating and handling earth under those conditions. The canals were arranged and dimensioned and the work divided into contracts of a size and character to facilitate the use of the most suitable machinery in the most advantageous manner. This treatment of the case secured contract bids for executing the entire work for 15 per cent less than the engineer's estimate of cost, which was based on ruling prices for that class of work, besides promoting its rapidity and securing in many cases more desirable construction than would have been provided for by strict adherence to theoretical design.

CAMP BOAT ON MAIN DITCH WHICH WAS EXCAVATED BY 4-YARD DREDGE

INSTALLATION AND OPERATION OF DREDGES

It is stated by L. L. Hidinger, vice-president of the Morgan Engineering Company, Memphis, Tenn., who designed and supervised the work, that the only machine which has been found to be an unqualified success in excavating earth in the heavily timbered lands in the Mississippi delta is the floating dipper dredge. Generally speaking, the size and strength of machines for this work are determined by the strength and power necessary for uprooting large stumps. It is found that the most economical machine for the smaller lateral ditches is a $1\frac{1}{2}$-yd. dredge floating on a hull about 20 ft. wide with a draft of about 3 ft. and length of boom 45 to 50 ft. Such a machine can dig a mile of ditch through timbered lands cheaper than any smaller machine of different type can dig a ditch half as large. A few laterals in open fields were planned with a bottom width of 4 ft., side slopes of 1:1, and a depth of 8 ft. Yet when bids were called for it was found that the construction of these laterals with a bottom width of 4 ft., through open plowed fields, would cost about $200 a mile more than the construction of ditches 14 ft. wide on the bottom through heavily timbered land where there was a water supply for floating dredges. The cost of excavation with a floating dipper dredge decreases as the size of the machinery and the size of the channel excavated increases, up to a point where a cross-sectional area of 500 or 600 sq. ft. is reached.

The most economical work can be done in constructing a ditch about 40 ft. wide on the bottom and 10 ft. deep. For sizes beyond this the cost of the work gradually increases until a cross-sectional area of about 1250 sq. ft. is reached, at which point the floating dipper dredge as at present constructed has about reached its limit. Moreover, in the construction of very large channels a heavy waste bank is formed which frequently has a tendency in alluvial soils to break down by sliding or crushing.

SIZE OF PLANT

The smallest machine installed had a dipper capacity of 1 yd. and a boom 40 ft. long. This machine did not give satisfactory service. The boom proved too short to place the waste bank at the required distance from the ditch. Later, the machine was rebuilt to give the boom an effective length of 43 ft., and is now giving satisfaction.

The largest dredge on the job has a rated dipper capacity of $4\frac{1}{2}$ yd., and a boom 80 ft. long. Two other dredges of the same dipper capacity, but with booms 70 and 75 ft. long respectively, were installed on the work. These dredges are all equipped with bank spuds. For this heavy equipment the removal of stumps is of minor importance. The most severe strains are produced in the A-frame and spud arms when the boom with loaded dipper is swung to the side.

The excavation work was divided into sixteen contracts, the basis of sub-division being to include in each contract: First, ditches of uniform size that would be adapted to some particular type or size of machine, and second, ditches that were connected so that the dredge could be floated to the various parts of the work, thus saving the expense of tearing down and moving the machinery overland. In the layout of these contracts, an attempt was also made to have the building point for the dredge at or near a railroad, or where the machinery could be transported by water to the building point.

Care was taken that enough yardage was included in each contract so that the overhead charges of installation would be minimized. The contracts were so laid out that, barring serious delays, each dredge would complete its work in two to three years. At the time contracts were let, bids were received on such a basis that it was found desirable in some cases to unite two contracts and allow their construction with one machine, it being agreed that the large machines mentioned above would be placed upon the work. The contracts were laid out in such a manner that the dredges could usually operate down stream.

It makes no difference in the operation of a dredge whether it is working up-stream or down-stream, provided a sufficiently high stage of water can be maintained at the point of operation to insure a low exposed working face. However, in digging up-stream the ground surface rises, and unless dams are built behind the dredge from time to time, it is soon working at a disadvantage. When more than 3 or 4 ft. of bank, or "face" as the dredge men call it, shows above the surface of the water, with a dredge properly designed to operate under normal conditions, it becomes necessary to raise the water level so that the dipper may clear the spoil bank.

Investigations of Explosibility of Coal Dust

IN his annual report just made to the Secretary of the Interior, Joseph A. Holmes, director of the U. S. Bureau of Mines, states that excellent progress has been made during the past fiscal year in the investigations of the explosibility of coal dust at the experimental mine near Bruceton, Pa. These investigations included a careful examination into the inflammability of coal dust collected from hundreds of mines in different coal fields and a systematic study of the possibility of coal-mine explosions starting from the improper use of explosives or the use of improper explosives, or from electric sparks, miners' lamps, mine fires or other agencies.

During the year four types of explosion-stopping devices in which rock dust is used were developed, as follows: Box barriers, concentrated barriers, ventilating-door barriers, and ventilation-stopping barriers. The barriers were tested in strong and in weak explosions and were effective in preventing propagation of flame beyond them. After being placed in a mine they are easily inspected and require little attention. Demonstrations before mining men led to inquiries from a number of companies, with a view to the erection of the devices in mines.

The results of the tests at the experimental mine have shown the value of watering and of steam humidifying systems, and the peculiar merits of rock dust, both when distributed throughout the mine and when used as barriers for limiting explosions.

Methods of Creating and Maintaining Channels at Mouths of Fluvial and Tidal Rivers

Elmer L. Corthell, Speaking from an Experience of 46 Years, Tells of Mississippi River Works and Discusses Fundamentals of Stream Control

When studies for controlling the Mississippi River at its delta were in progress in 1874, Elmer L. Corthell advised James B. Eads to construct two parallel jetties or dikes at the mouth of one of the three passes or outlets where sand bars in the sea, produced by the deposit of sediment, seriously obstructed navigation. After Mr. Eads had explained to a Senate committee how the shoaling of the channels and the formation of the obstructing bars were caused by the fan-like expansion of the water the committee asked him what he proposed to do. He replied, "I propose to shut the fan."

This incident is cited by Mr. Corthell, in a paper presented at the recent meeting in Philadelphia of the American Association for the Advancement of Science, to show that, in general, the successful method of maintaining channels at the mouths of fluvial and tidal rivers consists in concentrating the flow by means of parallel jetties, with dredging as an auxiliary only. The basic principle of all such work, Mr. Corthell states, is to make the stream create and maintain its own channel by building works to contract the channel and therefore increase the velocity of flow. While dredging processes have greatly improved and have cheapened the removal of material, they never can, according to Mr. Corthell, be substituted in good practice for parallel, permanent works. Basing his conclusions on 46 years of experience in river control Mr. Corthell enunciates certain principles and rules for guidance in the design of hydraulic works. An abstract of his paper follows:

Making Currents Do Work

Mr. Eads' plan for regulating the south pass of the Mississippi—involving parallel jetties 2¼ mi. long, extending into deep water beyond the submerged bars at the river's mouth—was carried out under Mr. Corthell's direction as resident engineer. Without going into the details of the works or their beneficent results it is sufficient to say that they produced the channel required by the charter—"26 ft. deep and 200 ft. wide at that depth, with a central depth of 30 ft. without regard to width." The width between the parallel jetties was that of the pass itself. The results were accomplished practically by the current itself. Dredging, as an auxiliary to hasten the development of the channel and handle some sticky clay material, removed only 1 per cent of the whole amount excavated. The jetties intensified the westward littoral sea currents, and the foreshore was swept clean of all deposits, and new deposits were prevented. A recent chart from a survey of the year 1914, 35 years after the 30-ft. channel through the bar was obtained, shows a least depth of 34 ft. the entire length of the works out into the deep water at the sea and a greater foreshore depth than originally existed when the works were begun in 1875.

An interesting subsequent history of works at the mouth of the Mississippi bears importantly upon the subject of channel maintenance. In 1874, when Mr. Eads went to Congress with his proposition, he asked for the right to improve the southwest pass by means of jetties, but after vain attempts to persuade Congress to give him this pass he was told he must expend his efforts and money on the small, unused south pass, one-quarter the size of the southwest pass.

In 1893, nearly 20 years after Mr. Eads was before Congress, Mr. Corthell introduced a bill in the United States Senate to give him a charter to construct jetties and auxiliary works for creating and maintaining a wide and deep channel between the southwest pass of the Mississippi River and the Gulf of Mexico. The channel proposed was to be 33 ft. deep and 250 ft. wide at that depth, with, no doubt, a central depth of 38 to 40 ft. No payment was to be made until a channel 24 ft. deep and 250 ft. wide had been obtained. It was a "no cure, no pay" concession, similar to that of Mr. Eads at the south pass. The bill was referred in due course to the Secretary of War, who advised that the concession be not given. The success at the south pass had removed all doubts as to the success of such works, and the Government itself intended to undertake it rather than private parties. Nothing, however, was done by the Government.

Errors in Mississippi Plan

In 1908, however, a board of three army engineers reported favorably upon a general plan and layout of works for the southwest pass which were quite similar to those proposed by Mr. Corthell in 1893. Unfortunately, Congress would not consent to the plan on account of its cost, and in the next River and Harbor Bill, of March 3, 1899, a provision was made for a new board to be appointed by the President, which should consist of four engineers of whom at least two should be from civil life. This mixed board cut the estimate of the Army Board in two, so that the result was eminently successful and satisfactory in respect to economy, but the success of the board's project ended there.

The principal erroneous features of its plans were as follows:

1. Widths between the jetties varying from 3,000 to 7,000 ft., instead of 2,400 ft. of uniform width between parallel jetties.
2. The resting of the sea ends in only 20 ft. of water, instead of 30 ft., as the Army board proposed.
3. The proposition to remove by dredging two-thirds of the 22,000,000 cu. yd. required to be excavated to create the channel, instead of using dredging as an auxiliary.
4. The plan of raising the works only to the surface of the water, instead of 4 ft. above it, as proposed by the Army board.

Fallacy of Dredging

The principle on which the plan was based was radically wrong, according to Mr. Corthell. Instead of having the permanent works *create* the channel, with dredging as an auxiliary, the board proposed to *create* the channel by dredging, the office and purpose of the works being simply to protect it from the deposit of sand in the channel from the outside. The idea clearly expressed was that as the improvement in dredging appliances, particularly by hydraulic or suction processes, had reduced the cost of such work in such locations and conditions to 4 cents per cubic yard, it was good policy to create the channel by dredging. That is, dredging is cheap, therefore the more of it the better. With this principle adopted it was good engineering not to build jetties in deep water but on the outlying shoals, which at the mouths of the Mississippi and all other delta rivers prepare the ground for the advancing banks; in fact they are submerged and incipient banks.

The plan of the works as laid looked very much like a coffin, being at its widest point between the shoals, 7,000 ft. wide. The fact that an immense amount of heavy sediment—about 300,000,000 cu. yd.—would be brought down by the river into this pass during the three years of construction, all of which would have a tendency to drop into the artificial channel created by dredges, was not appreciated.

Mr. Corthell made a vigorous protest against the adoption of the plan. However, the works were carried out on practically the plans prepared by this board. The results have fully confirmed Mr. Corthell's prediction of 1900. The results have been very disappointing to commerce at least. Much of the dredging which was estimated to cost 4 cents per cubic yard has cost 14 cents, or more. With all the efforts made by four powerful dredges, inside the completed works, to make and maintain the channel, the limiting depth in June, 1914, was only 27 ft. The deep ships are still using south pass, with its least depth of 34 ft., and the wide, straight channel to the sea. This channel is maintained without dredging through the entire length of 2½ mi. of the jettied channel. The troublesome question now is how to contract the waterway in the southwest pass jetty channel to a uniform width of, say, 2000 ft. Either a series of spur dikes, or wing dams, from the main works, or interior, parallel jetties must be built to insure the permanent channel required and its maintenance.

Fundamental Principles

Where sea bars exist, and where it is practicable to build connections with the shores successful works must possess the following features:

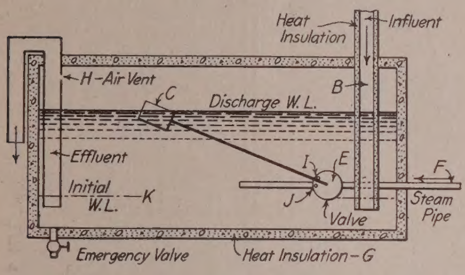
1. Parallel jetties must be connected with the shore.
2. The distance between jetties must be that of those sections of the river where the best channel exists by nature.
3. Jetties must project straight out into the sea.
4. Sea ends of jetties must rest in about the depth of water required for the channel, and present the best situation for the action of the sea currents moving past the sea face of the works.
5. Jetties throughout their entire length must be carried well above the high tide to prevent the deposit of sands in the channel from the outside.
6. Construction must be rapid to prevent the reformation of the bar in front during the progress of the works.

The Tampico harbor works, in Mexico, at the mouth of the Panuco River, illustrate Mr. Corthell's principles and suggestions and are claimed by him to be among the most successful works of the world. They were built in 1891, the period of construction being not longer than a year and a half.

Steam Disinfection for Sewage on Common Carriers

U. S. Public Health Service Has Devised Apparatus for Use on Railway Coaches and Lake Vessels—Costs of Construction and Operation

STEAM for sewage disinfection is employed in a device suggested by Prof. Earle B. Phelps and designed by Leslie C. Frank, both of the U. S. Public Health Service, for use on railway coaches which pass over watersheds, and on vessels which, according to the findings of the International Joint Commission, have been responsible in large measure for the pollution of the Great Lakes near the intakes of municipal water supplies. The apparatus, as described by Mr. Frank in the Jan. 1 number of the "Public Health Reports" consists of a chamber insulated by some heat-insulating material, *G*, such as magnesia cement or sawdust; an influent pipe, *B*, penetrating nearly to the bottom of the tank; an effluent pipe, *A*, penetrating nearly to the bottom of the tank, and perforated at some point, *H*, near the top of the tank by a small hole about ⅛ in. in diameter; a steam pipe, *F*, provided with an ordinary straightway valve, *E*, and a float, *C*. The lever handle of the straightway valve has been removed and replaced by a disk, at the center of which is freely pivoted the lever arm of the float, *C*, and which disk is provided with two pins, *I* and *J*.



STEAM DISINFECTION APPARATUS

OPERATION

The operation of this device is as follows: Assume that the initial water level in the tank is at *K*. The steam valve, *E*, is in its closed position and the influent pipe, *B*, is submerged below the water level. In other words, the influent pipe, *B*, is always trapped, even at the times of minimum water level in the tank. The entrance of sewage into the tank through B causes the level of the water in the tank to rise gradually and to carry the float upward with it. The float arm, however, is pivoted freely upon the steam-valve disk and therefore does not turn on the steam by revolving the disk until it engages the pin *I*; that is, until the liquid in the tank has reached a certain predetermined height, dependent upon the position of the pin *I*. When this height of water is reached the steam is gradually turned on. For a time the entering steam is immediately condensed and gives up its heat to the water. The water thus becomes heated at a rate dependent upon the rate and pressure of the steam discharge. As the temperature of the water approaches the boiling point the steam ceases condensing in the water but rises through the water and collects in the chamber space above it. At about the boiling point of water, or a trifle above, the pressure develops in this upper space and gradually forces the sewage up and out through effluent pipe, *A*.

As the liquid discharges the water level and the float descend, the steam, however, remains turned on full until the float arm engages the pin *J*, when a slight further descent shuts off the steam. The level of liquid at which the steam is shut off and at which discharge from the tank immediately ceases may be predetermined by the position of the pin, *J*. The small hole, *H*, is provided to enable the air in the tank to escape as the sewage enters. The relation of the size of this hole to the total cross-section areas of the steam influent openings is such that only a very small percentage of the steam entering through the pipe, *F*, can escape through the hole, *H*, and therefore pressure develops in the tank practically as fast as if hole *H* were not present. This hole may be replaced by a simple thermovalve, which will be open below, say, 80 deg. C. and closed above that temperature, but the percentage of steam escaping through *H* is so low that it is doubtful whether the inclusion of such a valve is warranted.

TESTS OF EFFICIENCY

A test was also made to determine the mechanical and germicidal effect of the action of the device upon human wastes. The device was used six times as a toilet and then operated. The effluent seemed to be almost homogeneous, the lumps of fecal matter and the pieces of toilet paper having apparently been macerated by the violence of the steam action into very small bits. It was apparent that most of the fecal matter was actually dissolved in the water and samples collected in bottles appeared at first sight to be simply a yellowish liquid until closer inspection revealed a small amount of fine, suspended matters. Bacterial samples were collected and tested for total bacteria and for B. coli. The results of these tests showed a total count of 11 bacteria per cubic centimeter, and a total absence of B. coli in 100 cu. cm. The tests, Mr. Frank states, indicate that the germicidal efficiency of the device is practically 100 per cent and the disinfection efficiency actually 100 per cent.

COST

The container need not be over 12 to 15 in. high, 12 to 15 in. wide, and 4 ft. long. Preliminary cost studies indicate that the construction of the disinfector should not cost much over $2 per cubic foot capacity, non-installed. The installation cost will vary with the conditions of installation. The capacity of the disinfector for steamers should be about one hour's flow during the hour of maximum usage. The capacity for railway trains may probably reasonably be placed at 3 to 4 hours' flow. It is estimated that the flow from one steamer closet during the maximum hour of usage will not exceed 8 cu. ft. This, with the estimated capacity cost, makes the uninstalled construction cost per closet about $16. The two closets on a railway coach will probably not discharge more than 2 cu. ft. in the maximum hour, or in 4 hours 8 cu. ft. The uninstalled construction cost per railway coach will therefore probably be from $15 to $20.

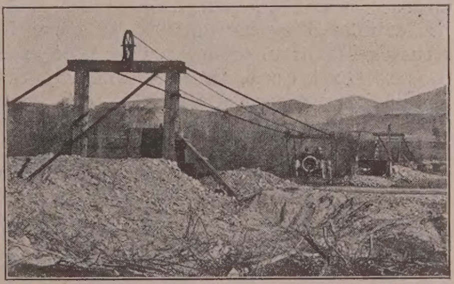
Preliminary studies of the cost of operation indicate that with steam as heating agent the disinfection of one steamer closet flush will cost $0.001, or $1 per thousand closet flushes. On the same basis the disinfection of one railway coach closet flush would cost about $0.000075, or 7½ cents per thousand flushes. Therefore, if each steamer closet discharges on the average 50 times every day, the cost of disinfection per day per closet on steamers will be 5 cents. If each railway coach toilet discharges 100 times every day, the cost of sewage disinfection per coach per day will probably not be over 1½ cents. It is believed that these assumptions of toilet usage are, if anything, excessive, and that the actual average annual cost of steam disinfection would be considerably less than 365 times the above daily estimates.

Flat Steel Ropes Support Aerial Ferry for Automobiles

A CABLEWAY of novel design for ferrying automobiles or other vehicles across the Gila River has recently been put in service at Gila, N. M. It consists of two flat steel ropes each ½ x 5 in. in cross section, spaced 8 ft. apart and having a main span of 340 ft. The cables are anchored to deadmen buried in the river bed, and pass over 12 x 14-in. timber piers 14 ft. above the bed of the stream. Each cable is 670 ft. long, the additional length being required in order to reach ground suitable for the deadmen. The slack in the secondary span between piers and anchorages is taken up by heavy stone counterweights.

Four double-flanged wheels 1 ft. in diameter run on the cables, and from them is suspended a platform built upon 2 I-beams 18 ft. long and 6 in. deep, designed to carry 20,000 lb. The frame joining the double-flanged wheels connects with an endless cable ⅝ in. in diameter, which runs over 30-in. vertical sheaves at either shore and passes around a 72-in. horizontal drum at one end, to which is attached a horse sweep. The car usually makes the trip from landing to landing in about 3 min.

The heaviest load normally carried is about 10,000 lb., although when the cable was completed a load of 20,000 lb. was carried across to test the bolts and deadmen. The cables have a breaking strength of about 120,000 lb.



AERIAL FERRY FOR VEHICLES

The ferry was built by Thomas Lyons, of the Gila Farm Company.

THE VISUALIZING OF DIMENSIONS is facilitated in the layout drafting room of the Crane Company, of Chicago, by means of a long scale board marked off in feet, placed lengthwise of the long room near the ceiling, where every man can see the figures without getting up from his desk. Heights are fixed in the men's minds by a vertical scale board.

Substructure of the Trent River Bridge

Features of Concrete Pedestals for Steel Towers and of Wooden Abutments Built to Avoid Retaining Walls in Fresh Banks

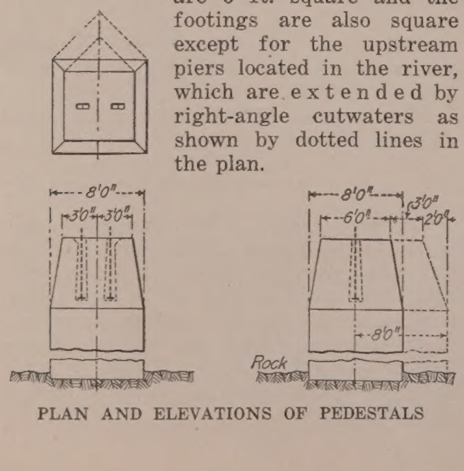
A SINGLE-TRACK plate-girder structure spans the Trent River on the new line of the Canadian Pacific Railway east of Toronto known as the Campbellford, Lake Ontario & Western Railway, the general features of which were described in the Engineering Record of June 13, 1914, page 675. At each end of the bridge there are high embankments and to avoid the use of solid retaining walls on fresh banks the abutments are wooden skeletons that permit the slope of the fill to pass through them and extend nearly to the bottom of the first tower. The remainder of the substructure consists of separate concrete pedestals for the tower columns. These are typical of the construction adopted for similar conditions on this line and are provided with long anchor bolts arranged to permit initial displacement to provide for erection adjustment.

The abutments are three-bent framed wooden towers seated on sills bearing on the leveled surface of the rock fill, and are made chiefly of 12 x 12-in. timbers and 3 x 10-in. diagonal bracing. The vertical and batter posts are gained into the caps and sills, and the track is carried across the top of the tower on six 10 x 18-in. stringers. A transverse wooden bulkhead wall about 3 ft. deep across the top of the shore bents retains the ballast and the upper part of the fill, while below its lower edge the earth slopes unimpeded through the tower at an angle of about 1½ : 1.

COST OF WOODEN ABUTMENTS

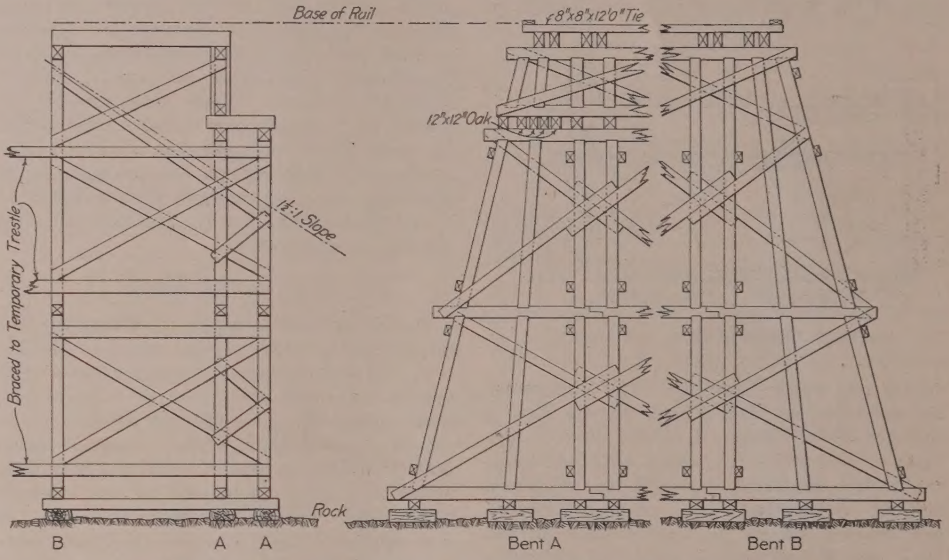
A platform of 12 x 12-in. longitudinals on the tops of the two shore bents receives the bearing for the plate-girder span and also supports a pony bent under the ends of the wooden track stringers. The abutments contain about 48,000 ft. b.m. of timber, detailed in accordance with the standard plans for high trestles. Their estimated cost is $960 each, as compared with the estimated cost of $2500 for concrete structures of the cantilever wing type used for the Dixie Creek tube described in the Engineering Record of Sept. 19, 1914, page 318. The assumed life is from eight to ten years.

The pedestals for the tower columns have footings extending from low-water level, or from the surface of the ground, to solid rock. They support battered shafts extending just above high-water level, or above the surface of the ground. The tops are 6 ft. square and the footings are also square except for the upstream piers located in the river, which are extended by right-angle cutwaters as shown by dotted lines in the plan.



PLAN AND ELEVATIONS OF PEDESTALS

Each pedestal was provided with two vertical 2-in. anchor rods set in holes about 5½ ft. deep cored out of the concrete. These holes were 6 in. square at the top and 8 in. square at the bottom and were drained by a 3-in. inclined pipe. The square top was enlarged by a 6 x 6-in. funnel-like extension on one side to receive the grout which was poured in to a depth of about 2½ ft. when the anchor bolts were set. This left about 4 ft. of the upper end of the bolt free to be moved in any direction in order to match the hole in the column base, and also permitted the latter to be set in exactly the required position, after which the holes were grouted full, fixing the bolts against farther displacement. Care was taken to exclude moisture from the upper part of the holes before the latter were finally grouted.



FRAMING OF WOODEN ABUTMENT USED ON TRENT RIVER BRIDGE

The work was designed and constructed under the direction of P. B. Motley, bridge engineer of the Canadian Pacific Railway.

Reduced Production of Portland Cement in 1914

Estimate of U. S. Geological Survey Shows Decrease of Nearly 4,000,000 Barrels — First Decrease in History of Cement Industry

ACCORDING to preliminary returns from all operating mills in the United States except one it is estimated by Ernest F. Burchard, of the U. S. Geological Survey, that the quantity of Portland cement manufactured in the United States in 1914 was approximately 88,514,000 bbl., as compared with 92,097,131 bbl. in 1913—a decrease of about 3,583,000 bbl., or nearly 4 per cent. The estimated shipments during 1914 were 86,715,000 bbl., as compared with 88,689,377 bbl. in 1913, a decrease of about 1,975,000 bbl. or 2.2 per cent. On account of the surplus of production over shipments, stocks of cement at the mills apparently increased more than 14 per cent, or from 11,220,328 bbl. in 1913 to 12,818,000 bbl. at the close of 1914. It may be necessary to revise downward the figures for stocks, as the estimates furnished by some producers undoubtedly included more or less unground clinker, but it is believed that the figures for production and shipments are very close to those that will be shown later by exact reports from cement producers.

The Lehigh district of eastern Pennsylvania and western New Jersey produces more cement than any other section of the United States—about 28 per cent of the total production. This district showed a decrease of more than 9 per cent in both production and shipments. The Illinois and northwestern Indiana district, which is next in importance, with an annual output of more than 11,000,000 bbl., showed a slight decrease, and the Pacific coast district (California and Washington,) which is third in importance and produces about 8,000,000 bbl., showed a decrease of about 12 per cent. Important increases in production and shipments were shown by New York State, the Iowa-Missouri district, the Maryland-Virginia-West Virginia district, and the Rocky Mountain district.

Although only general statements as to selling prices are at hand, it is evident that the average value per barrel was slightly lower than in 1913. Slight increases in prices are reported from a few plants in the Eastern States, but decreases were reported from the majority of plants in all districts.

An analysis of the general comments on prices shows that 65 per cent of the mills received a lower average price for Portland cement during the year just closed than in 1913; at 23 per cent of the mills practically the same prices prevailed, and 12 per cent of the manufacturers report having received higher prices. The low prices in certain districts have been ascribed in part to overproduction. With regard to the general trade as indicated by the demand for cement, about 50 per cent of the manufacturers suffered from adverse conditions which developed during the last half of the year, coincident with the foreign war. Of the remainder, 35 per cent reported the demand as about the same, and only 15 per cent reported a better demand. Where the demand was the best prices were little affected.

One new plant, at Superior, Neb., was added to the list of producers during 1914, two or three plants changed hands, and a few that produced in 1913 were not operated in 1914. One new mill was reported to be under construction at Gold Hill, Ore.

NEARLY 1000 MILES OF NEW RAILWAYS were put into operation in the Province of Alberta, Canada, during 1914, according to a recent consular report. The total mileage is now 4250, having doubled since Dec. 31, 1911.

Water Turbine Characteristics

Method of Obtaining Characteristic Curves for High-Power High-Speed Wheels, and Explanation of Their Application

By GEORGE H. BANCROFT
Teaching Assistant in Hydraulic Machinery, University of Michigan, Ann Arbor, Mich.

IN the Engineering Record of Nov. 28, page 585, and that of Dec. 26, 1914, page 689, Prof. S. J. Zowski, of the University of Michigan, presented two articles entitled "Some Recent Tests of High-Power High-Speed Water Turbines." The characteristic curves of several such wheels are given. Such curves as these show very completely the true characteristics of a wheel, and by a study of the curves the problem of selecting a wheel for a given installation may be solved in a very satisfactory manner.

The purpose of the present article is to show how these curves are obtained, and to interpret them by observing their general shape, illustrating by a few examples their use in solving practical problems.

The characteristic curves of a wheel can be obtained in no way other than from the readings of an actual test made on the wheel. The turbine should be tested at several different gate openings, varying from full open to nearly closed. For each gate opening a variable speed test should be made on the wheel covering a range of speeds from zero to a maximum or runaway speed. Readings should be taken for each speed to determine the total head, brake horsepower and quantity of water used. From these values of head and quantity the power input for the turbine may be computed. The power output should be measured by a mechanical brake of some kind. An electrical measurement of the power output is not feasible, as the speed cannot be lowered below that for maximum power.

PLOTTING THE CURVES

The computed results of the test will show three variables for each gate opening, namely, speed, efficiency and capacity. The latter may be expressed either in quantity or power. Inasmuch as the tendency of the present practice is to base efficiency guarantees on power rather than on the quantity discharged, or gate openings, we will consider power instead of quantity as a measure of capacity. Before using the three variables in plotting curves, the power and speed should be reduced to their equivalent values at some constant head. This head is usually taken as one foot. (The efficiency is not affected by this reduction). Since the speed of the wheel varies as the square root of the head, we may say that the number of revolutions under 1-ft. head is $N_1 = N/\sqrt{H}$, where N is the speed in revolutions per minute. The power of the wheel is dependent on the quantity and the head, and since the discharge varies as the square root of the head, the power varies as $H\sqrt{H}$. The power under 1-ft. head will then be $\text{hp}_1 = \text{brake hp}/H\sqrt{H}$.

The values of hp_1 and the efficiency may now be plotted, using the speeds N_1 as abscissæ in each case. We will have then a horsepower-speed and an efficiency-speed curve for each gate opening. At any definite speed we will see from these curves that the efficiency varies with the power. Also, at any constant power the efficiency varies with the speed. In other words, the efficiency of the turbine is a function of two variables, speed and power. The relation of these three variables may be shown by a three-dimension drawing in which the power and speed are used as abscissæ. The surface of a solid shown in this way will represent the characteristics of the wheel. The shape of this surface may best be shown, in the plan view, by contour lines which are the loci of points of equal efficiency. The surface as shown in this way may be compared to a topographical drawing of a hill, where we have instead of line of equal elevation, lines of equal efficiency.

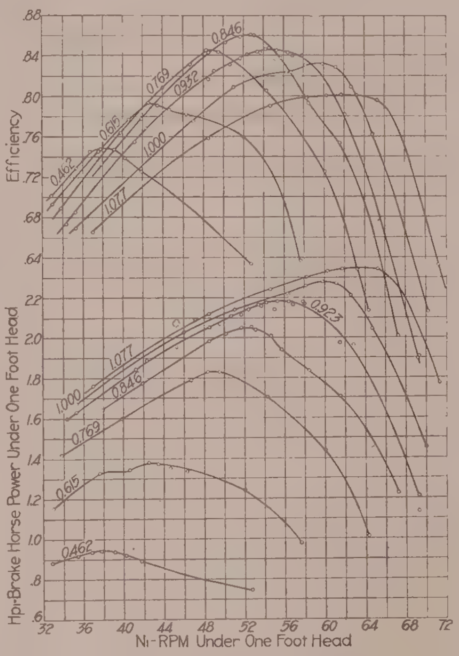


FIG. 1—CHARACTERISTICS OF 28-IN. WHEEL

POINTS OF EQUAL EFFICIENCY

Points of equal efficiency may be located in the following way. Referring to the efficiency-speed curves of Fig. 1, we see, for example, that the ordinate of 82 per cent cuts the efficiency curve for gate opening 0.769 at a speed of $45.6N_1$ and again at a speed of $52.8N_1$. It also cuts efficiency curve for gate opening 0.846 at a speed of $46.0N_1$ and $56.8N_1$. We find likewise the speeds at which the line of 82 per cent efficiency cuts the efficiency-speed curves for the other gate openings. These speeds are now located on the brake horsepower-speed curves (shown dotted on a new sheet, Fig. 2) for the corresponding gate opening, and a smooth curve is drawn connecting these points. We then have a curve which shows all the possible combinations of speed and power which will give 82-per cent efficiency. This same process is followed out in determining lines of equal efficiency for other values of efficiency, and we have finally our characteristic curves shown in Fig. 2.

It will be noticed that we have but two points on the curves for 86-per cent and 85-per cent efficiency. At 84 per cent we have six points and at 83 per cent, eight points. It would, of course, be impossible to determine the correct shape of the curves for 85-per cent and 86-per cent efficiency from the two points which we have located. But after having drawn the equal-efficiency curves for 83 per cent and 84 per cent, which are well determined, we may draw the other two by using a little judgment. We know, for instance, that the curve of 85 per cent must have the same general shape as that for 84 per cent. Further, we see from the curves of Fig. 1 that the gate opening 0.923 gives an efficiency of almost 85 per cent at a speed of $55N_1$, hence the equal-efficiency curve for 85 per cent will be almost tangent to the power curve for gate opening 0.923 at that same speed of $55N_1$. Also, we see from Fig. 1 that the least speed which gives 85-per cent efficiency is about $49N_1$ and the maximum speed for the same efficiency is about $55N_1$. The 85-per cent equal-efficiency curve will then be tangent to these two speed values. We may now draw the curve with a great deal of accuracy. The curve for 86 per cent may be drawn in the same way.

In drawing the curves for 75, 76, 77 and 78 per cent there might be some question as to the points where they cross the speed of $42N_1$ at the lower powers. We may aid ourselves here by plotting a curve of efficiency upon horsepower as abscissæ for a speed of $42N_1$. Points for this curve are obtained by noting the corresponding power and efficiency for the different gate openings at a speed of $42N_1$ as given by Fig. 1. From this curve we may determine at just what power we get a certain efficiency at the given speed, and this value of power, speed and efficiency will locate a point on the equal-efficiency curves.

THE EFFICIENCY HILL

In drawing the curves of Fig. 1 the points of the test should be followed out as closely as possible and the curves should not be smoothed out to correct what may seem to be little irregularities in the test. All smoothing out should be done on the equal-efficiency curves and this may be done here in the most rational way. The curves of equal efficiency should show a gradual change in curvature from one to the other, thus giving a smooth surface to the efficiency hill.

From these final curves the point of best efficiency can now be determined with almost absolute accuracy as the peak of the efficiency hill. The speed of the wheel giving maximum efficiency may be termed the best speed of the wheel.

OVERGATING

It will be seen in Fig. 2 that the equal-efficiency curves are very crowded for maximum power. This means that the efficiency surface is very steep here and indicates that the wheel has a rapid decrease in efficiency for increasing power, and therefore has very little overload capacity. There is always a certain gate opening which gives the maximum power, and for larger opening the power falls off, caused by the fact that the quantity no longer continues to increase with the gate opening. This is what is termed overgating and where it occurs the equal-efficiency curves no longer continue to envelop one another, but rather overlap, or cross and go under each other, thus forming a cave in the side of the efficiency hill. This is a very important matter and should receive a great deal of consideration in drawing the characteristic curves, otherwise one is likely to misjudge the overload capacity of a wheel.

Figs. 2, 3 and 4—Three Types of Wheels

In Figs. 2, 3 and 4 there are represented characteristic curves for three different types of wheels, each type being adapted to a certain requirement and having decided advantages over the other two for that particular case. In Fig. 3 the characteristic curves show a broadness in all directions. The wheel has a very flat power-efficiency relation for any given speed and is capable of developing large overloads. The characteristic shown in Fig. 2 shows a broadness in only one direction. The power-efficiency relation for a given speed is not as good as in the case of Fig. 3. The wheel has no great overload capacity, but shows a high efficiency over a greater range of speed, therefore making it better adapted for varying heads. Fig. 4 shows a type which is still better suited for a variable-head condition, since the ridge of the efficiency hill is inclined more toward the vertical. This wheel also develops a greater overload than the one represented by Fig. 2, but does not come up to the wheel of Fig. 3 in this respect.

Now let us apply these characteristic curves to the solution of a practical problem for which we wish to make efficiency guarantees. Let us assume that we wish to develop continuously 6000 hp at 125 r.p.m. The head varies from a minimum of 22 ft. to a maximum of 32 ft., with a normal of 27 ft. Let us make our guarantees on the basis of a wheel which has characteristics as shown in Fig. 3. We will assume that the wheel is to have its best speed, that is, best efficiency, at normal head. The best speed under 1 ft. head will then be $125/\sqrt{27} = 24$ r.p.m. Our 30-in. wheel (Fig. 3) has a best speed of $48N_1$. Since the speed varies inversely as the diameter, the diameter of our wheel of the same type will be $30 \times 48/24 = 60$ in. The scale of the coordinates in Fig. 3 will now have to be changed on account of the change in the diameter of the wheel. The scale of speed will be multiplied by the ratio of the diameters (30/60). The power varies as the ratio of the diameter squared and the scale will be multiplied by $(60/30)^2$. For all heads other than normal the wheel will have to be either overspeeded or underspeeded if we are to maintain the speed at 125 r.p.m. under any head. When the head goes down to 22 ft. the wheel will have to be overspeeded. The N_1 of our 60-in. wheel will then be $125/\sqrt{22} = 26.7$, or $(26.7 \times 60/30) = 53.5N_1$ on the scale of our 30-in. wheel. Likewise, at a 32-ft. head the wheel will have to be underspeeded and our 60-in. wheel will have a value of $125/\sqrt{32} = 22.1N_1$. On the scale of our 30-in. wheel the speed will be $22.1 \times 60/30 = 44.2N_1$.

Explanation of Table

Now at the three speeds of $44.2N_1$, $48N_1$ and $53.5N_1$ of the 30-in wheel we may read the values of efficiency and horsepower under 1-ft. head and tabulate them as shown in the accompanying table. Columns 1 and 2 show the efficiency and power as read from the curves of the 30-in wheel. Column 3 shows the horsepower corrected for the change in diameter. Column 4 shows the power of the 60-in. wheel under the given head.

The efficiency guarantees may now be plotted for the three speeds as shown in Fig. 5. The curves show the efficiency and power for a single 60-in. wheel when under 22, 27 and 32-ft. head. In order that we may develop 6000 hp at all times we must use 6000/1200 = five wheels when the head is down to 22 ft. At 27-ft. head we would use 6000/1500 = four wheels at 89.4-per cent efficiency. Under 32-ft. head three wheels would be required.

The above example illustrates only in a general way how the characteristic curves may be used in making efficiency guarantees. In our problem we assumed that the wheel was to run at maximum efficiency under normal head. This may be regarded as only one of many conditions which often arise. It may be necessary at times to design the wheel so that the maximum efficiency will be at some head other than normal. In that case the wheel size will not be figured as in the above example from the speed at which the best efficiency is obtained, but from some other speed such that the maximum efficiency will be obtained at the required head. Often the efficiency is not the only important consideration and the problem becomes of such a complex na-

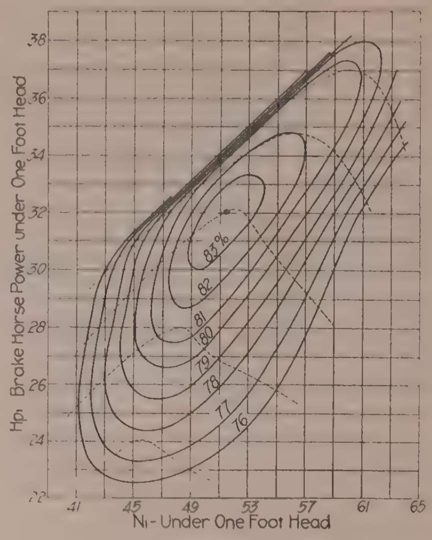


FIG. 4—CHARACTERISTICS OF WHEEL 2068

Diameter, 30 in.
Best efficiency, 83.2 per cent
Best speed, 51.8 N_1 r.p.m.
Normal power, 3.20 hp
Normal K_t, 92.8 (specific speed)
Designer, S. J. Zowski

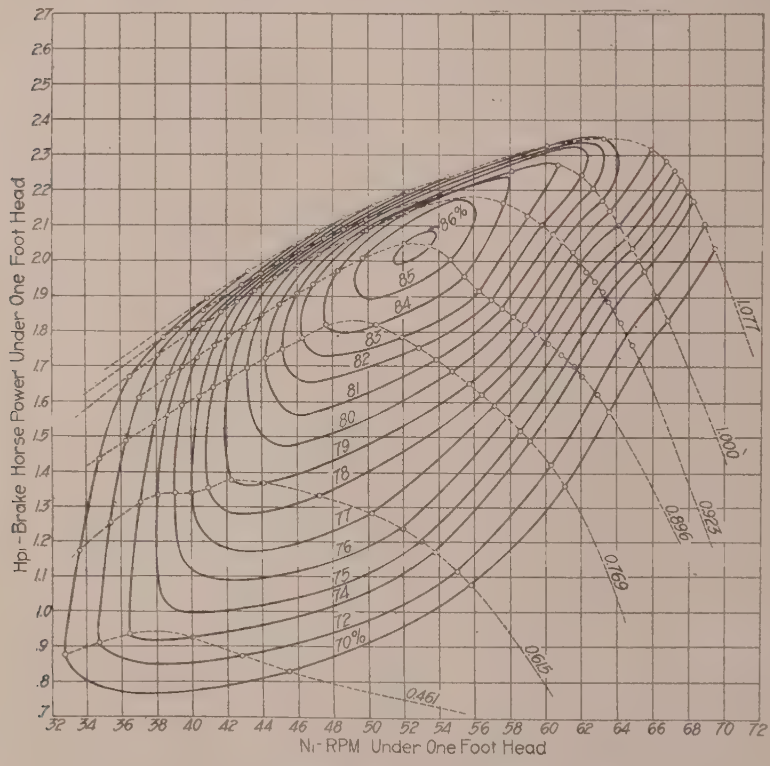


FIG. 2—CHARACTERISTICS OF WHEEL 1796

Diameter, 28 in.
Best efficiency, 86.2 per cent
Best speed, 52.2 N_1 r.p.m.
Normal power, 2.04 hp
Normal K_t, 74.5 (specific speed)
Designer, C. W. Larner

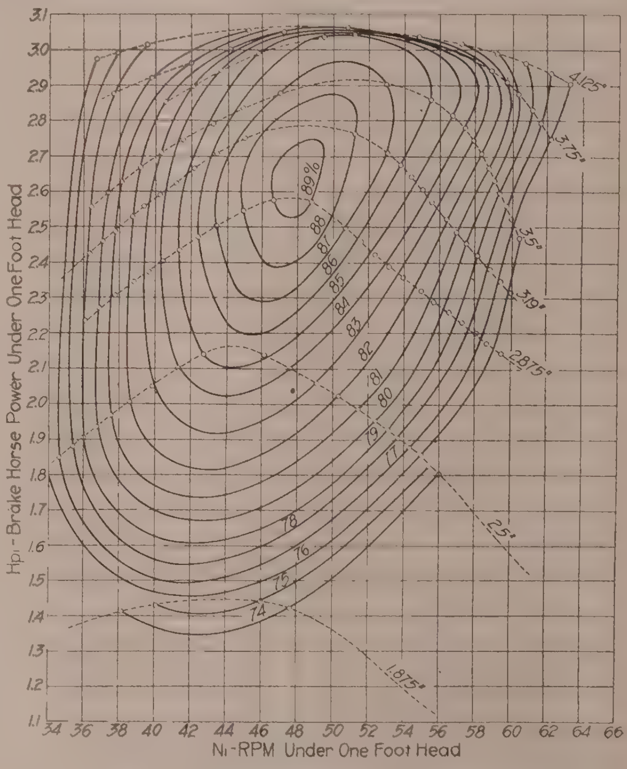


FIG. 3—CHARACTERISTICS OF WHEEL 2121

Diameter, 28 in.
Best efficiency, 89.2 per cent
Best speed, 48.0 N_1 r.p.m.
Normal power, 2.65 hp
Normal K_t, 78.0 (specific speed)
Designer, S. J. Zowski

ture as to require a great deal of careful study before a satisfactory solution can be obtained.

The flow conditions of a river are often such that the quantity of water available at a given time requires the highest possible efficiency under those conditions. The wheel must then have such a diameter that it will give maximum efficiency under the available head at that critical stage of the river.

PRACTICAL EXAMPLE

Let us now figure the diameter of the wheel for our problem stated above, assuming that we are to have maximum efficiency during the dry season when the head is 32 ft. Since the wheel is to run at 125 r.p.m., its speed under 1-ft. head will be $125/\sqrt{32} = 22.1N_1$. The diameter of our wheel should therefore be $30 \times 48/22.1 = 65$ in., instead of 60 in. Referring to the speed scale of the 30-in. wheel the efficiency guarantees may now be plotted at the speed of $48N_1$ for maximum head, at a speed of $24.1 \times 65/30 = 52.2N_1$ for normal head, and at $26.7 \times 65/30 = 57.8N_1$ for minimum head.

There are cases where the head varies in such a way that the percentage of maximum overspeed is far greater than the percentage of underspeed. If under these conditions the wheel is selected such that it will have best efficiency at normal head, then at extremely low heads the speed will fall outside of the range of the wheel. In such cases the wheel must be underspeeded at normal head. This means that the diameter, and consequently the power of the wheel, is reduced, making it necessary to install more units. We are limited then in the choice of our wheel in two directions. On one side we are bound by the efficiency we are willing to allow at low head, and on the other hand by the number of units we could economically install.

Let us illustrate this point by considering a case when the head has maximum, normal and minimum values of 20, 15 and 8 ft. respectively, a speed of 100 r.p.m. being required at all times. The speed of the wheel when reduced to 1-ft. head for the three cases will be as follows: $100/\sqrt{20} = 22.3N_1$; $100/\sqrt{15} = 25.9N_1$; $100/\sqrt{8} = 35.5N_1$. The conditions require an overspeed of $(35.5 - 25.9)/25.9 = 37$ per cent and an underspeed of $(25.9 - 22.3)/25.9 = 13.9$ per cent. Consider now the wheel shown in Fig. 3. If the wheel is selected for best speed at normal head, then at 37 per cent overspeed it would have a speed of $48N_1 \times 1.37 = 65.8N_1$, which falls outside the range of the test and gives us no results. Let us now underspeed the wheel 14 per cent for normal head. The speed will be reduced from $48N_1$ to $41.3N_1$. At 37 per cent overspeed we have $56.6N_1$, which falls well within the range of the wheel. The diameter of the wheel will be $30 \times 41.3/25.9 = 48.0$ in. and the maximum power under 8-ft. head will be about $3.0 \times (48.0/30.0)^2 \times 8\sqrt{8} = 173.5$ hp at an efficiency of 82 per cent.

This efficiency is undoubtedly greater than would be necessary, since there is an abundance of water at low head. We will now make a new trial and underspeed the wheel only 7 per cent instead of 14 per cent for normal head. This changes the normal speed of the wheel to $44.6N_1$, which gives a speed of $61.2N_1$ for 37 per cent overspeed. The diameter of the wheel will be $30 \times 44.6/25.9 = 51.75$ in. and its maximum power under 8-ft. head will be $2.95 \times (51.75/30)^2 \times 8\sqrt{8} = 198.0$ hp at an efficiency of 78.5 per cent, an increase in power over the 48.0-in. wheel of 14.1 per cent. Then in a plant where we wish to develop 1600 hp we will use eight units instead of nine. It may be allowable to lower the efficiency below 78.5 per cent, and this cut-and-try method may then be continued until a satisfactory solution is obtained.

WHEN NUMBER OF ALLOWABLE UNITS GOVERNS

Often the number of units allowable is the most important factor in determining the size and speed conditions of a wheel. With the wheels shown in Figs. 2 and 4 the maximum power increases with the speed. This in itself aids in reducing the number of wheels, since the unit power for overspeeded conditions is higher than the normal unit power. When a wheel similar to that of Fig. 3 is used the number of wheels may be reduced by increasing the power of each wheel. This may be accomplished by increasing the size of the wheel, which makes it necessary to overspeed it at normal head. If the 30-in. wheel of Fig. 3 runs at $48N_1$ for normal head (20 ft.) the maximum power will be $2.65 \times 20\sqrt{20} = 237$ hp at 89.2-per cent efficiency. If the wheel is overspeeded to $54N_1$ for normal head (20 ft.) the new diameter will be $30 \times 54/48 = 33.7$ in. and the power for a maximum efficiency of 86.6 per cent will be $2.9 \times (33.7/30)^2 \times 20\sqrt{20} = 327$ hp, which is an increase of 38 per cent.

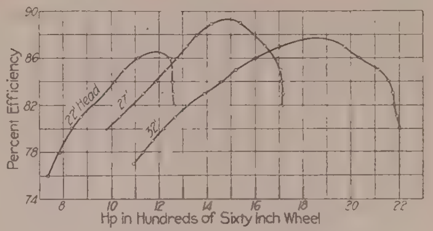


FIG. 5—EFFICIENCY GUARANTEES

POWER OUTPUT OF 30-INCH AND 60-INCH WHEELS WHEN RUN AT VARIOUS EFFICIENCIES AND SPEEDS

(1)	$N_1 = 44.2$ (2)	$N_1 = 44.2$ (3)	$N_1 = 44.2$ (4)	$N_1 = 48$ (2)	$N_1 = 48$ (3)	$N_1 = 48$ (4)	$N_1 = 53.5$ (2)	$N_1 = 53.5$ (3)	$N_1 = 53.5$ (4)
Efficiency per cent	Hp_1 of 30-in. wheel	Hp_1 of 60-in. wheel	Hp of 60-in. wheel at 32-ft. head	Hp_1 of 30-in. wheel	Hp_1 of 60-in. wheel	Hp of 60-in. wheel at 27-ft. head	Hp_1 of 30-in. wheel	Hp_1 of 60-in. wheel	Hp of 60-in. wheel at 22-ft. head
80	3.05	12.20	2205	...	....	....	...	....	....
81	3.03	12.10	2192	...	....	....	...	....	....
82	3.01	12.03	2180	3.06	12.23	1715	3.05	12.20	1264
83	3.00	12.00	2173	3.06	12.23	1715	3.04	12.16	1258
84	2.98	11.91	2158	3.05	12.20	1710	3.035	12.12	1255
85	2.92	11.78	2115	3.04	12.16	1705	3.03	12.10	1253
86	2.82	11.28	2040	3.02	12.09	1693	2.012	12.05	1247
87	2.73	10.92	1975	2.93	11.72	1642	...	....	....
88	...	....	....	2.85	11.40	1597	...	....	....
89	...	....	....	2.74	10.95	1537	...	....	....
89	...	....	....	2.53	10.12	1418	...	....	....
88	...	....	....	2.41	9.78	1358	...	....	....
87	2.35	9.40	1700	2.34	9.37	1312	...	....	....
86	2.21	8.85	1600	2.27	9.10	1272	2.665	10.65	1102
85	2.10	8.40	1520	2.195	8.80	1230	2.545	10.18	1052
84	2.02	8.08	1462	2.12	8.50	1188	2.45	9.80	1012
83	1.92	7.68	1390	2.02	8.09	1132	2.36	9.45	977
82	1.82	7.28	1318	1.92	7.69	1075	2.24	8.97	927
81	1.75	7.00	1268	1.84	7.37	1032	2.115	8.45	875
80	1.68	6.73	1217	...	...	....	2.02	8.08	836
79	1.62	6.48	1172	...	...	....	...	....	....
78	1.565	6.27	1132	...	...	....	1.90	8.60	786
77	1.515	6.06	1096	...	...	....	...	....	....
76	1.47	5.88	....	...	...	....	1.78	7.13	737
75	1.415	5.66	....	...	...	....	...	....	....

In many power plants where there is but little pondage the flattest possible power-efficiency curve is required. This may often be obtained by choosing a wheel to run at some other than its best speed. In such cases the maximum efficiency is lowered, but the efficiency of the plant may be raised considerably. This is especially true of single-unit plants.

These various conditions mentioned above are of prime importance in considering the all-year efficiency of a power plant, and it is surely this efficiency that we must always have in mind in making a selection of a wheel for any installation.

A Two-Mile Street Railway Tunnel at San Francisco

City Undertakes to Build Tunnel Under Twin Peaks That Will Bring 7000 Acres of Residence District Within 5 Minutes' Ride of Market Street

THE Twin Peaks tunnel, for which the city of San Francisco recently awarded a $3,372,000 contract, is planned for a double-track electric railway, and is to provide convenient access to an area of 7000 acres which it is desired to develop as a residence district, but which is at present shut off from the city by a range of hills. The east portal will open on Market Street, the city's principal commercial artery, and the west portal is in the center of the new home-site tract. The length between portals of the new tunnel will be 12,000 ft. and the time of transit for express trains is estimated at 5 min.

Funds for the construction of the tunnel have been obtained by assessments on property that will be benefited by the improvement. The total cost, including right-of-way lands, is estimated at $3,994,289, and of this amount $3,398,972 will be contributed by the 4153-acre tract west of Twin Peaks. The remainder will be assessed from the 660-acre tract east of the peaks. The rate of assessment ranges from ½ to 3½ cents per square foot, averaging about 2 cents. Property owners have the option of paying these assessments in full, or in ten annual installments, deferred payments bearing 7 per cent interest.

ALIGNMENT AND MATERIAL

The selection of tunnel grades was influenced by two considerations, the desirability of locating a station within a reasonable distance below the surface at a point about 3000 ft. from the west portal, to be known as Laguna Honda station, and the necessity for keeping the grade down to a maximum that would permit of high speed. Both these considerations were satisfied by an ascending 3-per cent grade from the east portal to Laguna Honda station and a descending grade of 1.15 per cent from this point to the west portal. On curves the maximum grade was reduced to 2.87 per cent.

Two stations are to be provided. Of these the most important will be Laguna Honda station which will be located 62 ft. below the surface. Beside the tracks in this station, platforms 10 ft. wide and 300 ft. long will be built and six 50-passenger elevators are to be installed. All of the surface depots are to be reinforced concrete structures finished in the Mission style of architecture.

In order to ascertain the character of the material to be encountered borings were made along the route at intervals of about 350 ft. These borings indicated that, for a distance of 5000 ft. on the westerly end, sand and incipient sandstone will be encountered, passing then into hard Franciscan sandstone for a distance of 4500 ft. and emerging therefrom into a red sandy clay for the remaining 2500 ft. to the easterly portal.

The inside dimensions adopted for the tunnel proper are 25 x 18 ft., and as the borings indicate the presence of considerable water, the arch is to be practically semicircular. In the floor design an inverted arch will be used. Throughout the length of the tunnel the contractor is given the option of using brick or concrete in the upper portion of the arch ring, but concrete is specified for the remainder of the cross-section. Limited clearance near the east portal will prevent the use of the standard curve arch on this part of the line, and for a distance of about 1650 ft. a double compartment subway with a slab top was designed.

DRAINAGE AND VENTILATION

A vitrified pipe is to be laid beneath the crushed rock ballast to carry off the seepage water which will gain access to the tunnel through weep holes placed in the base of the walls at intervals of about 25 ft. Near stations where leaks would be particularly unsightly, three-ply felt waterproofing is to be laid on the top and sides of the structure and covered with porous tile so that seepage can readily percolate to the weep holes. Throughout the entire tunnel a 12-per cent mixture of hydrated lime will be added to the concrete as a water proofing measure, and in addition a rich mixture of cement and sand is to be applied to the interior surface with a cement gun.

A horizontal slab of concrete is to run through the tunnel 5 ft. below the crown of the arch so as to close off this part of the cross-section for service as an air duct. This slab will have a thickness of 4 in. and a span of 19 ft., its weight being supported by 1 in. steel rods from the arch above spaced 10 ft. apart on center line. Motor driven blowers in two ventilating shafts will force fresh air down into this duct whence it will escape into the main tunnel through openings controlled by dampers, and will find its way out at stations or portals. The design will permit of the use of either a third rail or trolley system and the location and elevation of the eastern portal are such that the tunnel can be continued as a subway under Market Street with but slight alterations.

Plans and specifications were prepared by M. M. O'Shaughnessy, city engineer of San Francisco, and the contract is held by R. C. Storrie & Company who have until June, 1917, to complete the work.

Lake Traverses on Railroad Preliminary Work

Advantageous Use of Canoes in Making Quick Stadia Surveys in Unmapped Regions with Numerous Bodies of Water

By J. A. MAC DONALD
Ottawa, Canada

IN running preliminary line for railways in new and unexplored localities it is necessary to traverse the lakes and other larger bodies of water to determine which side of the water is the more suitable for the line. In making these traverses stadia can well be used for measuring distance and rise and fall of the ground, and for obtaining the other necessary topographical features of the country. Such a stadia party should consist of the surveyor, assistant, two rodmen and two axemen. There should be a small boat or canoe, which may also contain another man. A folding boat will be found the most convenient.

The traverse of a lake is made from one or more instrument stations or hubs, at or near the shore, the rodmen following the bank and giving side shots suitable distances apart. For rivers and narrow lakes there is an advantage in keeping one rodman on each side and surveying both sides at the same time. On wide lakes the survey will be made on one side only, the front rodman traveling away from while the rear rodman travels toward the surveyor.

The methods herein described were used by the writer on the Grand Trunk Pacific Railway. The country through which we were running our preliminary line had never been surveyed or mapped—in fact, much of it had never been set foot on by other than Indian hunters in remote times. It was necessary, therefore, to explore the country to some extent, at least in the immediate vicinity of the line. Lakes were very numerous in that country. We would usually strike one about every mile or two. It was necessary for us to carry six Peterborough canoes with our party.

TWO PARTIES

In nearly all cases we divided our stadia gang into two parties, using two canoes. The first party for rapid work was made up of the surveyor himself, a rodman, a picketman, usually the head chainman, who also set the hubs, and one or two axemen, who also took charge of the canoe when moving to the next instrument station, and who gave side shots. The second party usually consisted of the assistant or the transitman, a picketman, a rodman and one or two axemen. This party also had a boat of some sort.

Beginning at a station of the preliminary line near the bank of the lake, the instrumentman set up his transit, got his backsight and was ready to begin operations. Meanwhile the chief, with his party, found a suitable station for the next hub, which might happen to be a rock or ledge in the lake. If the lake or other body of water is wide, there are many advantages in setting up on a small island, as observations may be obtained to both banks. When the instrumentman was ready his rodman got into the canoe and began to give shots at various places along the banks of the lake. After the foresight on the next station had been given the head party took side shots in the vicinity before moving forward to set the next hub. The transitman's rodman and assistants, who had been giving him side shots, returned to the transit station and conveyed him to the next station. The picketman did not remain to give the backsight, but simply set up a crosshead for the purpose.

To facilitate the plotting of the traverse by the draftsman, a rough sketch of the water body was made on the right-hand page of the field book on the cross-section paper. The boatmen were instructed to paddle in as near a straight line as possible from one station to another, no matter what the direction might be. The line in the center of the page of the field book represented a straight line from station to station and the offsets are always at right angles to the direction. This made a distorted map, not at all like its true position, but gave the necessary information to the draftsman in camp who had never seen the lake or traverse.

ESTIMATING DISTANCES ON WATER

To make a fairly good sketch the instrumentman must be able to estimate distances on water. This he can usually do, but only after some experience. The amateur will greatly under-estimate distances over water; what he would consider but 600 ft. will probably be 800 ft. By observation of side shots, however, the instrumentman will soon be able to gage these distances correctly from his position to the banks, and also the distances from either station.

The surveyor in charge of the first party also took notes of whatever was thought to be useful for mapping, and with this double information obtained rapidly by the two units, working both independently and in unison, a mass of notes, topographical and otherwise, was obtained and brought into camp.

The field notes and rough sketch were plotted on the regular maps in camp by the draftsmen. There were usually two, one a small scale map of say 5000 ft. to the inch, and the other the regular 400-ft. scale plan.

In sighting on the water, or from bank to bank, there was seldom a vertical angle to read, as the water level precluded this possibility, unless there were deep rapids, as on some rivers, in which case the vertical angle had to be recorded and the proper distance correction made. But this was necessary, if at all, only on the main line, and seldom or never on side shots.

With two gangs of three or four men each, it is possible to traverse 10 or 15 mi. of lake or river in a day, and if sufficient topography is taken, and carefully mapped, the location line may be projected therefrom. In other cases the data obtained in the traversing may show where a more suitable preliminary line may run. In a new and only as yet partly explored country like much of Canada, the necessity for much traversing on preliminary railway lines is apparent.

PUMPS TO HANDLE STORM WATER from a 9½-ft. concrete sewer are being installed at Sacramento, Cal. The sewer main enters the sump house below sea level, and the effluent is delivered under pressure through a 7½-ft. main into the Sacramento River. The sump house is being equipped with three 30-in. and two 22-in. pumps, and the building is planned so as to accommodate more pumps when the amount of water to be handled requires it.

Heavy Car Dumping Plant Moved 214 Feet in 2½ Days

Steel Tower, 116 Feet High, Machinery, Boilers and Coal Pockets, Weighing 800 Tons, Were Handled as a Unit on Rollers

THE 800-ton steel-tower car-dumping plant of the Erie Railroad, at Cleveland, was recently moved 214 ft. in 2½ days, to its new foundation on the west bank of the Cuyahoga River. Although the plant was put in operation less than three years ago, the proposed construction nearby of one of the piers of the high level Detroit-Superior viaduct formed such an obstruction that the car-dumping plant could no longer be profitably operated in this place, and it became necessary to move it to the new site between Dec. 1, 1913, and May 1, 1914. The work was successfully executed by the John Eichleay Jr. Company, Pittsburgh. The company reinforced the structure, raised it, moved it, turned it partly around, moved it farther and lowered it to bearing on the new foundation in thirty days with standard apparatus consisting principally of beams, timbers, rollers and jackscrews.

TOWER 116 FEET HIGH

The plant moved consisted of a number of large and awkward structures and their machinery, which included the four-post steel tower 116 ft. high, weighing about 330 tons, the 140-ton engine and machinery, the 200-ton boilers and settings, coal pockets, engine houses, and a 111-ft. smokestack. The plant occupied a space 40 ft. wide and 198 ft. long. The tower is 38½ ft. wide and 56 ft. long on centers of columns, with a load of 250 tons on the front columns and 80 tons on the rear columns.

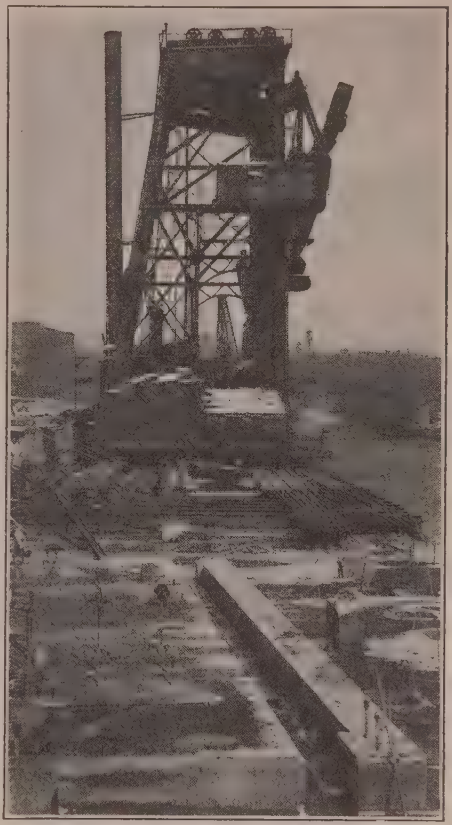
For part of the distance the plant was moved over a wide concrete slab 8 ft. deep with sufficient strength and enough foundation piles to distribute and support the load safely. For a distance of 98 ft. it was moved over a platform supported on transverse bents 6 ft. apart, each consisting of five vertical and three battered piles driven in hard clay. On this account it was necessary to distribute the load and reduce the load per pile to about 9 tons, which was accomplished so successfully that the plant was moved across it without serious settlement. A pile trestle was built to carry the tracks to the new site, the new foundation was built on 235 piles. The contract was awarded for moving the plant as a single unit in competition with two other bids received for moving it by the method of dismembering and re-erecting.

BRACING, LIFTING AND TRANSPORTING

The three Sterling boilers and their brick setting were securely clamped by I-beams, and the walls were needled, jacked up and seated on a timber grillage which received the rest of the plant excepting the two front columns of the tower. The base plate in each front tower column was seated on the bottom flanges of a pair of 24-in. I-beams, 16 ft. long, with their upper flanges cut to clear the column and bolted securely to it. These pairs of I-beams were set on three lines of longitudinal 12-in. I-beams 50 ft. long, which formed sills for the front half of the tower. The center sets of I-beams were only 18 ft. long, but the outer sets, 40 ft. long, overlapped 7 ft. at the center, making continuous lines over 70 ft. long extending beyond both ends of the tower.

The transverse planks, 14 ft. long, placed under the bottom flanges of the I-beams, afforded bearing for the short upper tracks; 8-in. wooden rollers, 4 ft. long, ran on oak planks laid on the top flanges of two pairs of continuous longitudinal I-beams for each set of rollers. Each of the upper track pieces was beveled at both ends to allow the movable rollers to engage it at once and clear it easily at the rear end, thus affording simultaneously, full bearings for sets of four rollers, with another loose roller between each set. The lower track beams were seated on the 20-in. I-beam cap of the pile bent.

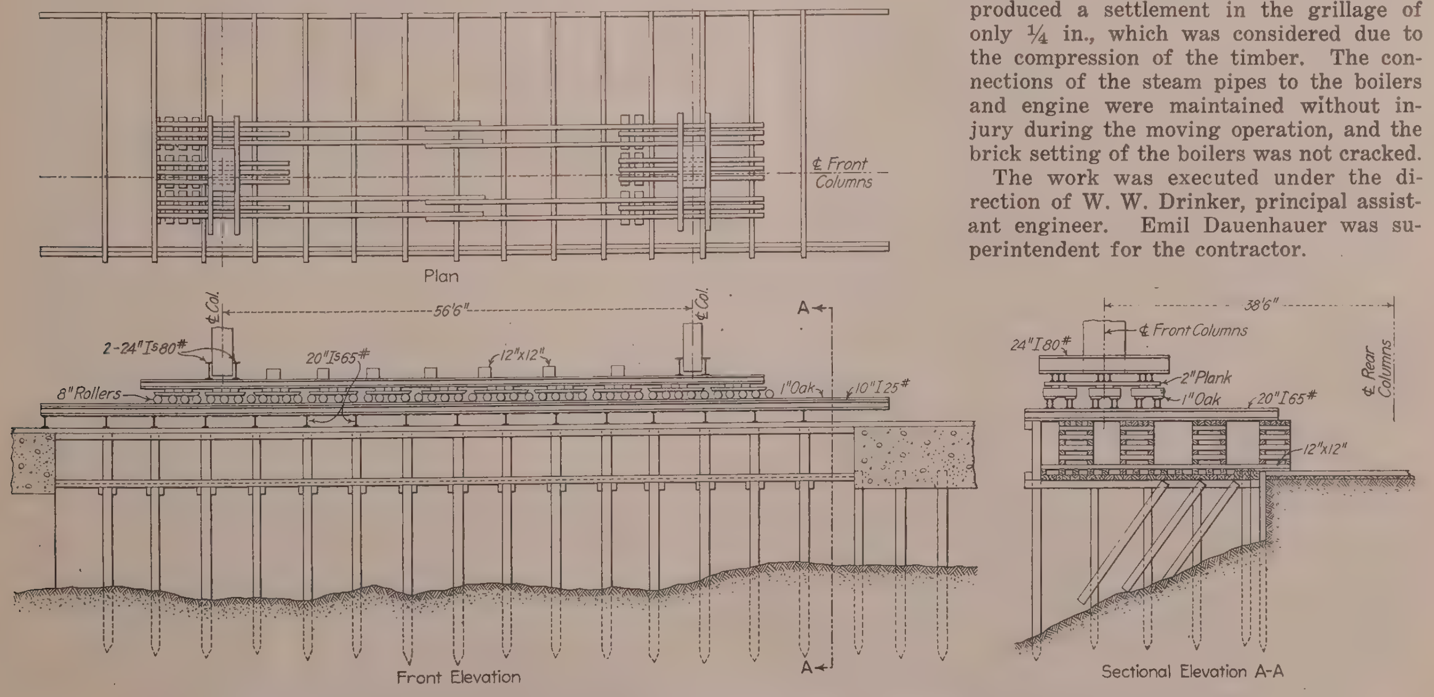
The 12 x 12-in. transverse timbers, 8 ft. part, were seated at one end on the upper 12-in. I-beams and extended across the full width of the tower, being also supported at the center and at the rear end on two more longitudinal lines or rollers supported on cribbing.


CAR-DUMPING PLANT IN TRANSIT

The weight of the coal pockets, smokestack, engine, machinery, and the remainder of the plant was transferred to the timber platform and the different portions of the structure and the framework were braced to prevent displacement or distortion. The structure was raised 35 in. in 2½ days by 230 jack-screws, and was supported on 350 rollers.

Two ten-part tackles were attached to the grillage supporting the plant and were operated by two-horse windlasses by which the whole plant was moved forward at the rate of 8 in. per minute. In one day the structure was moved 120 ft. and then, being allowed to remain standing over night, produced a settlement in the grillage of only ¼ in., which was considered due to the compression of the timber. The connections of the steam pipes to the boilers and engine were maintained without injury during the moving operation, and the brick setting of the boilers was not cracked.

The work was executed under the direction of W. W. Drinker, principal assistant engineer. Emil Dauenhauer was superintendent for the contractor.



PLAN AND ELEVATIONS OF TIMBER WORK USED IN MOVING HEAVY CAR-DUMPING PLANT AT CLEVELAND

Fireproof Ice-House at Lake Hopatcong

Design and Erection of a 900-Ton Steel-Frame and Hollow-Tile Building with 78-Ft. Unbraced Columns Which Replaced Wooden Structure

THE ice-house at Lake Hopatcong, N. J., is notable for its large dimensions, type of wall construction, mechanical equipment, ventilation and insulation, and the unbraced length of its columns. These features, together with construction details and the special wind-bracing system, suspended floor and movable conveyor platform are described in this article.

Heretofore wood construction has been universally used for ice-houses, but when in the summer of 1912 the Mountain Ice Company lost a large house and stock through fire at Lake Hopatcong, it decided to break precedents by constructing a tile and steel building. The advantages gained by the insulation in this construction more than balanced the increased cost over wood, and it is believed that this plant, described, is a pioneer in such use of fireproof materials.

GENERAL FEATURES

The building, planned to store 90,000 tons of ice, is 250 ft. wide by 326 ft. long, and consists of ten separate storage rooms, each 50 ft. wide by 150 ft. long, with a center conveyor aisle 25 ft. wide, from which ice is distributed into the five rooms on each side. The building is located 200 ft. from the shore of the lake, with a double-track railroad close to the shore wall. An inclined steel bridge, supported on steel towers, carries the ice conveyor from the water level over the railroad tracks into the central aisle. About 100 ft. from the rear or land side wall, there is an 18 x 32-ft. tower, which houses the operating machinery. The floor of the first pair of houses is placed 5 ft. above the track, and the floors of each succeeding pair step up by 2 ft. each, so as to provide drainage toward the lake.

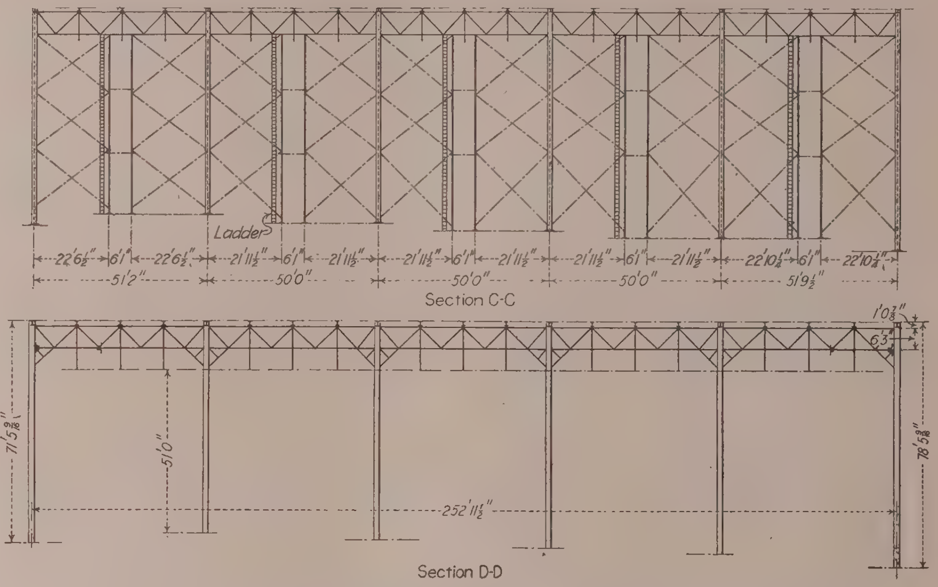
In the wall of each room next to the conveyor aisle there are two doorways 6 ft. wide for the full height of the room to provide for rapid storage of the ice in the winter season, and at the ends of the building, in the center of each room, a similar doorway gives opportunity for taking out the ice in summer.

The roof trusses are spaced 21 ft. 6 in. apart, and the columns are successively shortened, so that the roof pitches both ways from the center to the ends of the building.

The ceiling, or loft floor, is suspended from the roof by means of steel straps, which vary in length so as to keep the ceiling level. It is constructed of tongue-and-groove cypress boards, treated with Avenaries Carbolineum and covered with waterproof insulating paper.

The height of the lowest room is 57 ft. from floor to loft, and an important feature of all the rooms is the fact that this space of 50 x 150 ft. by 50 ft. high has no interior bracing to interfere with the ice storage.

The total weight of the steel work is 900 tons, and the heaviest piece weighs about four tons. The columns in the front, or lake side, wall at the center next to the conveyor aisle are 80 ft. long.



SECTIONAL ELEVATIONS SHOWING FRAMING AND END BRACING—LOCATIONS GIVEN ON PLAN

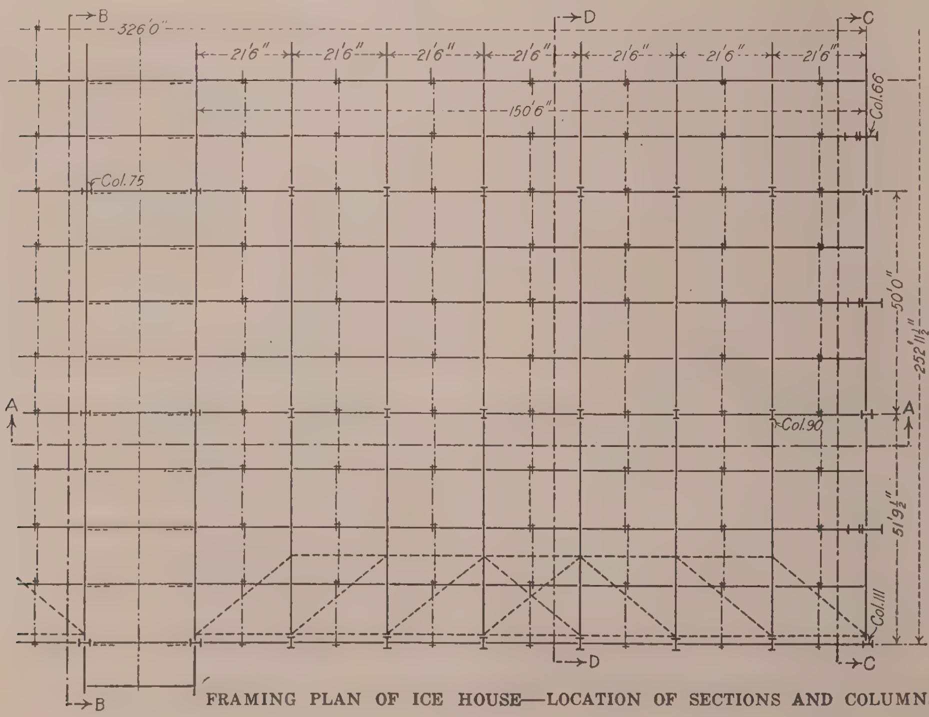
CONVEYING SYSTEM

The ice is taken from the lake on a double-chain endless conveyor. It is planed to size on the incline, and then passes to the center aisle of the building, where it is discharged into any of the storage rooms. The conveyor is driven by an electric motor in the rear tower, and is carried through the building on steel platforms connected by hinged joints, and suspended from steel cable drums placed under the roof. As the rooms are filled, the platforms are raised, and the varying length of the conveyor chain required for the different positions is adjusted by an automatic takeup. As considerable trouble is at times experienced in disposing of the planer chips, the rear tower has been placed 100 ft. from the building, so that the excess may be dumped behind the building, and allowed to melt in warm weather.

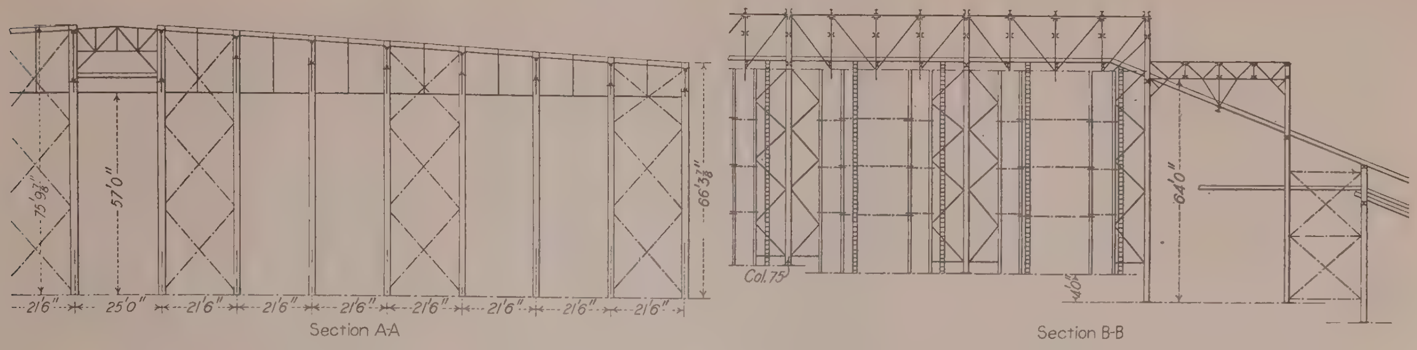
WALL CONSTRUCTION AND INSULATION

The exterior walls are double, and are built of two courses of 5 x 5 x 18-in. vitrified, single-duct, conduit-tile, laid horizontally and parallel to the plane of the wall, thus providing longitudinal closed air cells. The wall is 38 in. thick, made up in each course of two pairs of tiles, giving two outside walls 10½ to 11 in. thick, with an interior space about 16 in. thick, which is filled with sawdust up to the loft floor. The loft floor also is covered 1 ft. deep with sawdust. The walls are tied together with 2 x 3/16-in. galvanized wall ties, spaced 5 ft. apart horizontally, and 4 ft. vertically.

The partition walls are 10½ in. thick, made up of two courses of conduit tiles. The foundations are of concrete, and are made with double walls 12 in. thick, extending down 4 ft. below the floor line. They are sealed at the bottom with waterproof concrete. Between them is a 16-in. closed space filled with sawdust, thus carrying the insulation below the floors of the storage room. The partitions, or divi-



FRAMING PLAN OF ICE HOUSE—LOCATION OF SECTIONS AND COLUMNS



LONGITUDINAL AND TRANSVERSE SECTIONAL ELEVATIONS OF LAKE HOPATCONG ICE-HOUSE—LOCATIONS GIVEN ON PLAN

sion walls between the rooms, are without doors, and the rooms are accessible either from the two doors in the central aisle, the door in the outside, or, after the ice supply has been housed and these doors are sealed, through traps in the loft. The loft is ventilated by tiles run through the walls transversely, so as to give a number of openings 4 in. square.

STRUCTURAL STEELWORK

The latticed roof trusses are 6 ft. 3 in. deep, and, except at the end walls, are knee-braced to the interior columns. The 12-in. I-beam purlins are supported on the top flanges of the trusses, and carry tongue-and-groove planks covered by tar and gravel roofing. The wind pressure, assumed at 30 lb. per square foot, is resisted on the end walls by six longitudinal exterior and partition walls which frame into them. These walls are X-braced between the columns in the insulation space between the inner and outer walls. The latticed door columns in the center of the wall of each room are 24 in. deep, and assist in carrying the wind load to the roof trusses, where it is distributed to the walls by means of bracing. The wind pressure on the side walls of the building is resisted by the horizontal wind trusses in the planes of the bottom chords of the roof trusses. These trusses are riveted latticed girders 18 ft. 9½ in. deep, with wide connection plates field-riveted to the bottom flanges of the roof trusses.

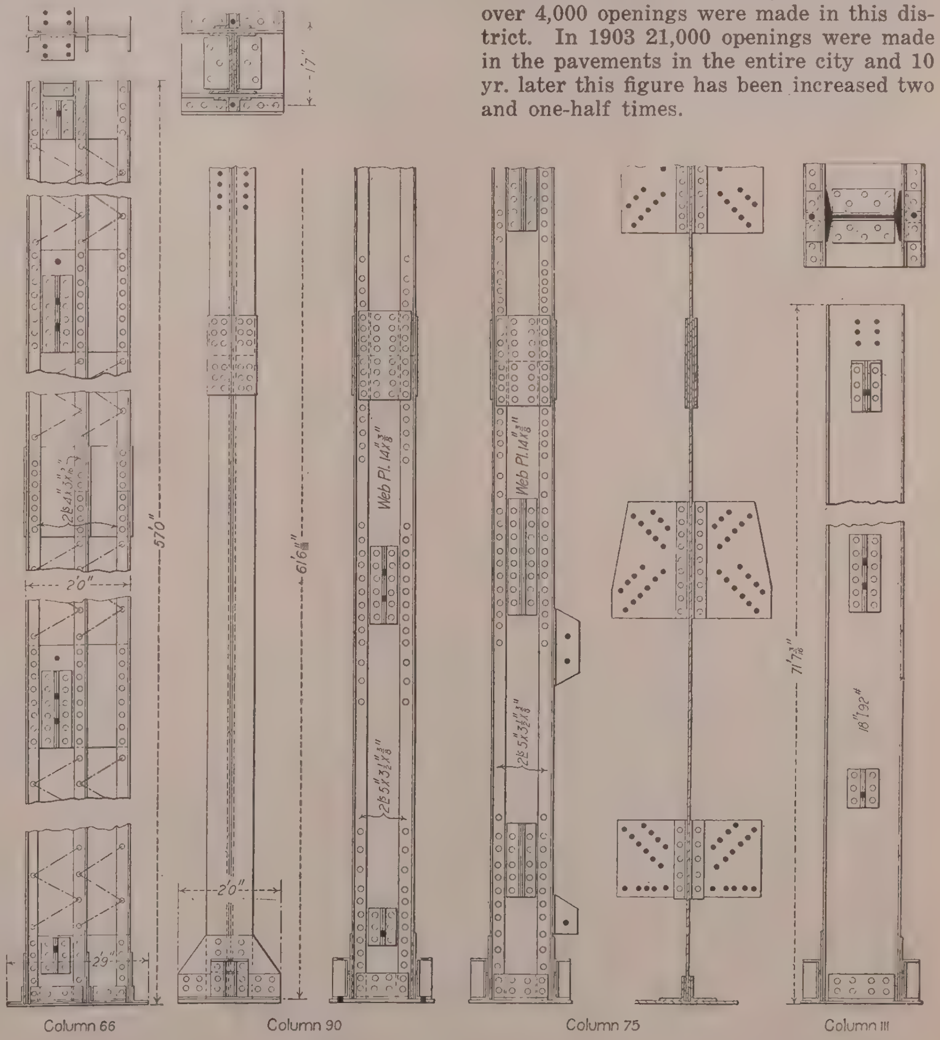
All of the columns have I-shaped cross-sections, most of them built up of a solid web-plate and two pair of flange angles similar to column C 90 shown in one of the drawings, which is typical of the regular interior columns. The columns adjacent to the center aisle are similar to column C 75, and are provided with gusset plates shop-riveted to the webs to afford connections for the X-bracing. The corner wall column and some of the others are single H-beams, similar to column C 111. The special wind columns in the end walls are made with three pairs of flange angles and two sets of web lattice bars, as shown in the detail of typical column C 66.

ERECTION OF STEELWORK

The structural steelwork was delivered on the railroad tracks running parallel and adjacent to the lake side of the building, and before any erection was begun, was all unloaded and distributed by a steel-tower traveler 30 ft. square and 30 ft. high, equipped with two 80-ft. steel booms and two 40-hp Mundy hoisting engines. The traveler track was laid on the floor of the second pair of rooms from the lake side, and ran through both rooms and the center aisle, a distance of about 300 ft. The 80-ft. boom next to the track lifted all of the material from the cars, and the boom on the shore side took the material required for the upper rooms from the lake-side boom, and distributed it in the third pair of rooms from the lake. After the steel was all distributed, the traveler was blocked up 4 ft., the wheels were turned 90 deg., and it was run to the fourth room from the lake side. Another track was laid in this pair of rooms for the full length of the building, and running on it, the traveler erected all the steel for the three pairs of rooms farthest away from the lake. After this was completed, the traveler went back to its old position and completed the erection of the last two pairs of rooms. All the steel was unloaded and distributed in seven working days, and erected in eighteen working days, by an average working force of sixteen men. The rivets were driven by four gangs with pneumatic hammers.

The building was designed for the Mountain Ice Company by Andrew D. Chidsey, architect and engineer, of Easton, Pa. The steelwork was fabricated and erected by Lewis F. Shoemaker & Company, of New York and Pottstown, of which Lewis D. Rights is contracting manager.

PAVEMENT CUTS in the central business district of Chicago, according to investigations by Louis A. Dumond, engineer of the Chicago Association of Commerce's committee on "downtown streets," number more than 50,000 annually. In 1911 in the loop district alone, 1500 openings are torn in its pavements, varying in length from 2 to 8 ft. Since that time this number has been increased. In fact in one year since 1911 over 4,000 openings were made in this district. In 1903 21,000 openings were made in the pavements in the entire city and 10 yr. later this figure has been increased two and one-half times.



DETAILS OF COLUMNS—NUMBERS REFER TO LOCATIONS ON PLAN

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Motor Trucks and Trailers in Freight Houses

E. H. Lee Gives His Experience as to How to Obtain Maximum Efficiency in Handling Less-Than-Carload-Lot Freight

ABOUT two years ago an investigation was made by E. H. Lee, vice-president and chief engineer of the Chicago & Western Indiana Railroad and the Belt Railway of Chicago of the methods and costs of handling less-than-carload-lot freight at outbound freight houses and on transfer platforms. Accurate observations were made of the performance of the one motor truck the company had in service at that time at its outbound freight house in Chicago. The data obtained were so satisfactory that two additional motor trucks were purchased and put into service. Since that time the company has effected various improvements in its system of trucking, including the use of trailers, and on Sept. 4, 1914, another series of performance tests were made. In the November "Bulletin" of the American Railway Engineering Association, Mr. Lee discusses the subject at length, and presents various tabulated data. His conclusions are as follows:

1. Motor trucks when used without trailers, tend to decrease the cost of trucking freight, because they form single units of higher capacity and greater speed than do men with two-wheel trucks; but as their cost of operation (per day) is greater than the cost of a man and a two-wheel truck, the saving is not large, and unless conditions are favorable (long haul, heavy packages, etc.), no saving is made. When compared with a man and a four-wheel (platform) truck, there is no saving, for the two have about the same carrying capacity, and the higher speed of the motor is more than offset by its greater cost of operation.

2. When used as power for hauling loaded four-wheel trucks as trailers, motor trucks show favorable results and greatly decrease the costs per ton. They can pull six times the load at twice the speed of a man with a four-wheel truck, at about twice the expense. Motor trucks should therefore be used to haul and not to carry freight. Under such a system they form an efficient, reliable and economical means of trucking freight.

3. To insure full train loads an ample supply of four-wheel or six-wheel trucks and dollies is necessary.

4. Motor trucks, when used as tractors, can handle practically all kinds of less-than-carload-lot freight.

5. Motor trucks need wide station platforms and open runways wide enough to permit two motor-truck trains to pass each other in order to secure the best results.

6. "Fouling points" or "interferences" should be reduced or eliminated entirely.

7. In motor-truck operation, distance is a relatively unimportant factor, for once a train is made up and in motion the cost per ton per 100 ft. is low.

8. Under fair conditions, on an ordinary freight platform, where the motor must operate largely as a way freight, it can handle from 150 to 200 tons per day per motor, and truck from 10 to 15 ton-miles.

9. Under ideal conditions, where the motor can operate as a "through freight," i. e., pull a solid train of five or more trailers from origin to destination without stop and with few or no delays, a motor can probably be expected to handle from 250 to 500 tons per day, or do from 30 to 60-ton-miles of trucking.

10. The substitution of the four-wheel truck for the two-wheel truck, if conditions warrant, while it saves money, is particularly valuable because it may be a preliminary step to the use of one or more motor trucks, if volume of tonnage and local conditions indicate the need of a tractor. This method of procedure also eliminates the danger of installing motor trucks at a heavy investment expense, to perform work which the four-wheel truck used as a trailer will do more economically.

GROSS OPERATING REVENUES FOR OCTOBER, 1914, on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1169 per mile, showing a decrease of $145 or 11.0 per cent as compared with October, 1913. Operating expenses were $786, a decrease of $105 or 11.8 per cent. Net operating revenues, therefore, were $383—a decrease of $40 or 9.4 per cent, and operating income was $332—a decrease of $39 or 10.6 per cent. The operating ratio was 67.3 per cent, as compared with 67.8 per cent in October, 1913, and 63.0 per cent in October 1912. Considering the three main districts, the respective ratios for October, 1914, and October, 1913, were as follows: Eastern district, 70.5 and 73.6; Southern 73.7 and 68.3; Western, 61.9 and 61.8.

Wood Block Pavement without Cushion Layer of Sand

Experimental Section in Business Center of Chicago Laid Directly on Concrete Base and Covered with Hot Pitch and Sand

FOLLOWING European practice in the omission of a sand cushion Chicago has recently completed an experimental wood block pavement in front of the post office on the Dearborn Street side. The fact that no sand cushion was used between the blocks and the 8-in. concrete slab made it necessary to give the latter a sidewalk finish. On that portion between Jackson Boulevard and Quincy Street hot asphalt was spread over the concrete immediately before the blocks were laid. For the remainder of the pavement, north to Adams Street, the blocks were placed on the bare concrete and covered with a coat of hot pitch and sand. Blocks of yellow pine were purchased under the standard specifications of the Chicago Board of Local Improvements, which prescribe the use of 12 lb. of creosote oil.

LAYING WOOD BLOCK ON BARE CONCRETE BASE

FINISHING WITH COAT OF HOT PITCH AND SAND

The main reason for the experiment, as given by the city officials, is to find some method which will avoid the shifting of the sand cushion under vibration due to street cars and team traffic. Experience with blocks laid on bare concrete in Europe, as ascertained last summer by L. E. McGann, commissioner of public works, indicated that the method had merit.

TRAFFIC CENSUS

The post office block was considered an excellent place for an accelerated test of the method as the heavy traffic is augmented by numerous teams which stand along the curb while second class mail is being unloaded. A traffic census as taken by the Citizen's Street Cleaning Bureau between 8 a. m. and 5 p. m. is as follows: Feb. 28, 1907, 2557 vehicles; March 6, 1911, 3005 vehicles; August 25, 1912, 3103 vehicles; August 12, 1913, 2711 vehicles; March 12, 1914, 2910 vehicles.

In 1914 the traffic consisted, on a daily average, of 2050 horse-drawn vehicles, 53 mounted horses, 568 motor cars, 232 motor trucks and 7 motorcycles. During the same period 478 street cars passed the observer. On blocks north and south of the post office the total number of vehicles on Dearborn Street was 2546 and 2263, both less than in front of the post office. While the pavement in question did not receive its proper proportion of the passing traffic, the actual wear due to the standing teams undoubtedly compensated to no small extent.

Warped Concrete Surfaces

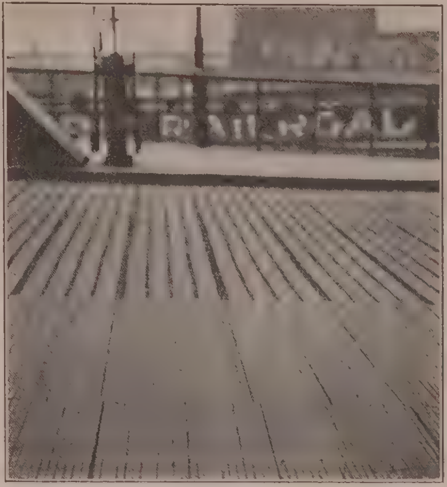
One of the most difficult parts of the new work was to obtain the proper warped surfaces due to the rise and fall of the gutter elevation between inlets to the level grade at the rail and to the corresponding elevations on the parabolic curves half way between the rail and curb. Only the west side of the street, 16.6 ft. wide from curb to rail, was paved. On top of the main body of the concrete, 1 x 6-in. dressed boards were secured at the rail and curb and bent over stakes set at the center. These boards were laid flat, 12 ft. apart, and a screed was used to strike off the 1½-in. coat of 1:3 mortar. Finishing was done from a bridge with a wood float about 1½ ft. long. For most of the work a Rapid mixer was used, the material being dumped back of the work on the subgrade. On account of congestion the last section of the concrete was hand mixed from materials stored on the sidewalk.

The work was done under the direction of Walter Leininger, superintendent of streets.

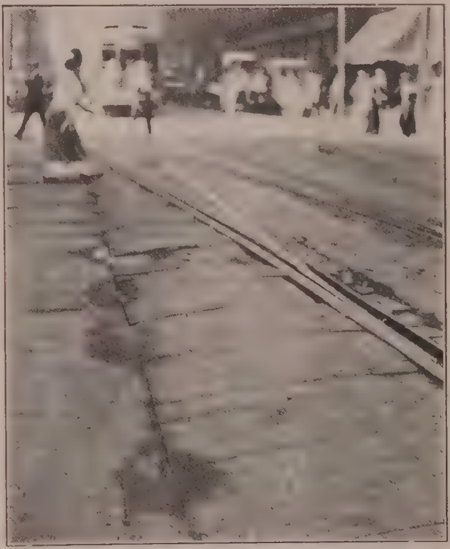
Wood Block Pavement After 6 Years' Service

Greatest Wear Occurred at Longitudinal Joints But Blocks Were of Sufficient Value to Relay on Approach to Ash Dump

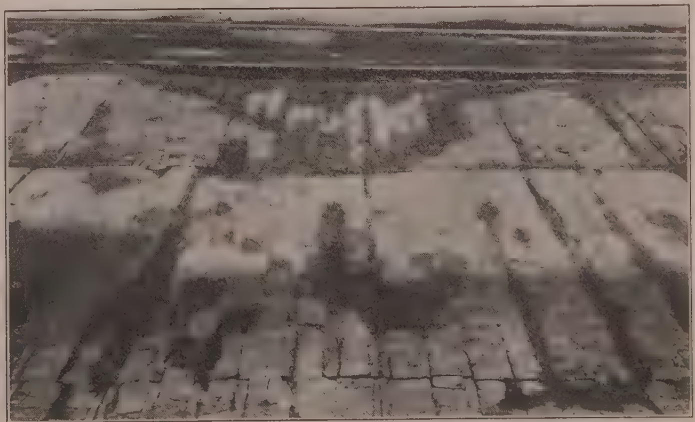
THE condition of the Shuman wood block pavement laid on the north end of the post office block in Chicago in September, 1908, is indicated in the accompanying photographs and shows the greatest wear at the longitudinal joints. After 6 years of use the blocks are still of sufficient value to relay on an approach to one of the city ash dumps. The pavement is used on the lift bridges in Chicago largely on account of its lightness. It consists of 1-in. maple strips 2½ to 3 in. deep dipped in hot asphalt and then bolted together flatwise in 2 x 4-ft. blocks. A top dressing of hot asphalt and sand is supposed to be applied at sufficiently frequent intervals to keep the maple from being exposed to appreciable wear. If this is not done moisture aids decays and the surface soon wears away rapidly under team traffic. The pavement is not recommended by the officials for street traffic and it was placed in front of the post office largely as an experiment. It can be laid quickly and removed and relaid in sections. Dearborn street at this point is full of underground conduits requiring frequent inspection. Interruption of the mail delivery service was a serious matter and as the city at large had to pay for the pavements the experiment could be carried out in the heart of Chicago without the interference of abutting property owners. The pavement was made of strips 5 in. deep instead of 3 in., as is usual for bridge work, and the sections were spiked to asphalted planks laid as mud sills.


SLOTTED AND SMOOTH SURFACES FOR UP AND DOWN GRADES

A variation of the above type was laid on the south end of the block. As shown in the photographs it comprises sections of wood blocks laid on end between binding strips. This type is used on the up-grade side of bridge approaches, but alternate strips are dropped slightly to give horses a toe hold. While few of the pavement sections actually gave way the blocks split up badly and the wear on the strips was such as to make the pavement uneven.


WEAR ON PAVEMENTS SIX YEARS OLD

PAVEMENT SECTION REMOVED FOR UNDERGROUND REPAIRS


CRACKED BLOCKS AND WORN STRIPS IN PAVEMENT

Underground Utility Galleries for Downtown Chicago

Abstract of Progress Report on Relief from Subsurface Congestion—Sub-Sidewalk Space Best Adapted to Comprehensive Gallery System

BEFORE embarking on a program providing underground galleries for public service utilities in Chicago, three questions must be answered, according to John W. Alvord and C. B. Burdick in a progress report recently submitted by them to the Commission on Downtown Municipal Improvements: Are utility galleries economically possible for the entire district or for certain streets, or is their construction warranted in connection with new improvements, such as the widening of Twelfth Street, the Michigan Boulevard link, subways and downtown paving?

The 50-page report states that not enough information is at hand to answer these questions. A comprehensive answer requires the co-operation of the public utility companies. The necessary studies to be made involve a determination of the cost to change the conduits from their present locations to a gallery; of the future needs, and probable saving possible to effect by gallery occupancy; of the cost and fixed charges for galleries; and, finally, a comparison must be made of all costs and benefits.

Conclusions

Some of the findings and principal conclusions evolved from the data in hand are as follows: In the 21-mile district north of Twelfth Street and south and east of the Chicago River, the 120 acres of pavement are valued at $2,000,000. Beneath the pavements lie 220 mi. of pipe and conduits plus an equal mileage of service connections. Pavement openings range from 2000 to 4500 in number, and the aggregate area in 1913 was more than 10 acres. In 20 years the occupancy of the district will be not less than twice that at present and will ultimately reach three to four times that at present. Though facilities must be enlarged the conduits now occupy all available space, but under an orderly arrangement the space is sufficient indefinitely.

Experience in London indicates that the change is not financially feasible except where streets are opened. In Chicago buildings are higher; a new sewer system, a high-pressure fire-protection system and subways must soon be installed. None of these problems can be solved rightly without caring for the utilities.

Savings by the use of galleries are $200,000 to $400,000 annually for street openings. There is to be expected a reduction in permanent maintenance cost of conduits, longer life for pavements, reduced operating cost of utilities, saving in cost of extensions, reduced leakage of gas and water, and a value to the public of good streets and decreased interference with travel. Rough estimates place the reproduction cost of sub-street utilities, public and private, between $10,000,000 and $13,000,000.

SUGGESTED MEANS OF RELIEF

Underground subways are the most frequently discussed means for relief, but there is no precedent existing in this country. A location in alleys is desirable in so far as alleys are available. The sub-sidewalk space has the advantage of surrounding each block so that new service connections can be made at a minimum expense, and there will be the least disturbance to continuous service. Construction could proceed at a minimum cost, for at least one side and the roof are already built on two-thirds of the street frontage. It is considered that this location is the best adapted to the gradual accomplishment of a comprehensive gallery system, but serious objection will undoubtedly arise from the present private occupancies.

Reinforced-Concrete Highway Trestle

Loadings, Distribution for Maximum Stress and Design of Standard Structure for the State of Arizona

By S. M. COTTEN
Chief Draftsman, Department of State Engineer, Phoenix, Ariz.

A REINFORCED-CONCRETE trestle with 16½-ft. spans combining economy and simplicity of outline with strength and light dimensions has been designed by the writer under the direction of T. F. Nichols, office engineer in the Engineering Department of the State of Arizona. The dimensions of the trestle are shown in the accompanying drawing. The pier web, or wall between supporting columns of bents, is to be carried 2 ft. above high water when the stream is subject to high floods and carries much drift, or as high as the prevailing conditions may suggest.

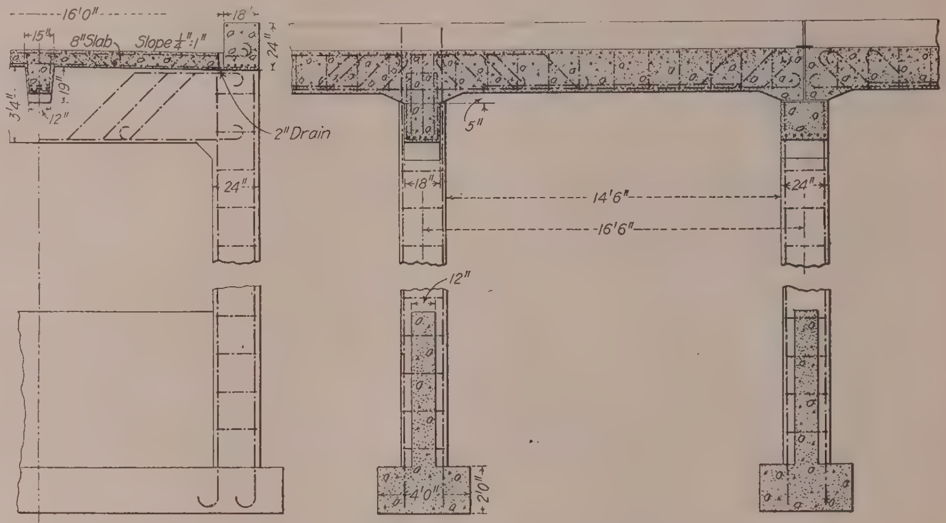
ASSUMED LOADINGS

For the design the following live and dead loads were assumed: Live load, 20-ton road roller with two-fifths of its weight on the front axle and three-fifths on the rear, axles 11 ft. on centers, front wheel 4 ft. wide, rear wheels 2 ft. wide and 5 ft. on centers; no impact allowance; dead load, applicable weight of structure assuming a unit weight of 150 lb. per cubic foot for reinforced concrete and 100 lb. per cubic foot for surfacing.

The positions of the roller giving maximum bending moments on the structure were determined. The dead weight was assumed as being uniformly distributed with one exception. For the central beam the maximum bending moment was found to occur when the rear wheels of the roller were placed at its center equidistant from it on either side, with the load assumed to be distributed over 4½ ft. longitudinally; for the curb beams, when one rear wheel was alongside of it at its center and its weight acted as a concentrated load; for the cross beams, when the maximum roller load was concentrated at its center. The position of the roller giving the maximum shear was also determined for all cases.

ASSUMPTIONS OF DESIGN

Because of the lightness of superstructure and piers, it was necessary that in general not less than three spans be considered as a unit, the center span being fixed, thereby securing the required longitudinal rigidity. This center span is fixed by rods from the posts and stirrups from the cross beam; the other spans have one end free. Because of the indeterminate degree of fixity, the lightness of the structure and unknown construction factors, all members affected were designed both as fixed beams and as beams freely supported, thereby securing the maximum possible bending moments for all possible conditions.



Half Transverse Section

Longitudinal Section on Center Line

DETAILS OF FIXED ENDS AND EXPANSION JOINTS OF STANDARD TRESTLE SPANS

Slabs.—The slabs were designed as beams fixed at the curb and at the center beams. They were reinforced for equal positive moment and negative moment throughout because of possible action as continuous beams.

Curb Beams.—The minimum dimensions of the curb beams were fixed as shown. They were reinforced throughout for maximum negative moments, regarded as fixed beams, and for maximum positive moments regarded as freely supported. The slabs were not considered effective.

Center Beam.—The center beam was reinforced on the same principle as the curb beams, but the design was based on T-beam action with a 36-in. flange. For the required end depth it was considered as a rectangular beam measured from the top of the slab.

Provisions were made in both center and curb beams for a negative moment throughout, due to possible continuity of spans.

Cross Beams.—The cross beams were designed as fixed beams. The bottom of the center beam is above the neutral axis on the compression side, and the beam is deeper than required in order to give bearing for the slab.

The columns are much in excess of requirements, as are the footings for all except the most difficult foundation conditions.

Unit stresses used were $f_c = 650$ and $f_s = 16{,}000$ lb. per square inch, with $p = 0.0078$.

NOTES ON CONSTRUCTION

Posts, web and cross beam are to be poured as a unit. Slab, curb beams and center beam are to be poured as a unit continuously between expansion joints. Expansion joints are to be placed at least as often as every third span; they are to be ⅛ in. wide, filled with asphalt, pitch or other suitable plastic material. Bearing at expansion joints is to be on tar paper. All corners are to be finished with a ¾-in. triangular bevel.

It will be understood that this design is applicable only to comparatively low crossings, not being economical for high structures. Bearing in mind the design assumptions, it is evident that merely by making slight modifications in the arrangement and quantity of steel this design can be made applicable to one-span or two-span units without requiring any computation, provided that longitudinal rigidity of the structure be maintained.

While this bridge is designed to withstand all possible contingencies of action, some of which are unlikely, and is considerably over-strong for its requirements, the dimensions are still as small as practice would recommend. The quantity of steel required by these combined assumptions is very little in excess of that required by any one of the assumptions, since it takes the place of special shear reinforcement which would otherwise have to be provided.

A SMALL RAILROAD operating an oil-burning locomotive on the Tahoe National forest, California, had a breakdown during the past summer and burned wood instead of oil for one day. On this day fifteen fires started along the right of way. During the preceding year only one fire occurred near the railroad and that was not attributed to the engine.

Book Reviews

The Interstate Commerce Commission has just issued its fourth annual report on the statistics of express companies in the United States. The report covers the year ended June 30, 1912, and contains forty-two pages, mostly tabular matter. (Washington, Government Printing Office.)

The annual report of the superintendent of the U. S. Coast and Geodetic Survey to the Secretary of Commerce for the fiscal year ended June 30, 1914, has been issued in its printed form. The book is 6 x 9 in. and has 128 pages and 16 inserted charts. (Washington, Government Printing Office.)

The source, manufacture and use of lime are discussed by Ernest F. Burchard and Warren E. Emley in a bulletin just issued by the U. S. Geological Survey, being the thirty-fifth subdivision of Part II, pages 1509 to 1593 of "Mineral Resources of the United States, Calendar Year 1913." (Washington, Government Printing Office.)

"Primary Triangulation on the One Hundred and Fourth Meridian and on the Thirty-Ninth Parallel, in Colorado, Utah and Nevada," is the subject of Special Publication 19 of the U. S. Coast and Geodetic Survey, by William Bowie, inspector of geodetic work and chief of the computing division, U. S. Coast and Geodetic Survey. The book is 9 x 11¼ in. and contains 163 pages and several illustrations of instruments and equipment used by the department. (Washington, Government Printing Office.)

"The Production of Coal in 1913" is the title of a separately printed section of the "Mineral Resources of the United States," comprising pages 709 to 928, inclusive. The author is Ernest F. Burchard. The report covers coal fields, labor statistics, mining methods, values, imports and exports, the coal trade review and the production of coal by States. At the end of the book there is a survey of publications on coal, coke, lignite and peat. (Washington, Government Printing Office.)

The Carnegie Library of Pittsburgh has issued recently a catalog entitled "Air conditioning," containing references to books and magazine articles on that subject. The catalog, which has been printed from the "Monthly Bulletin" of November, 1914, contains 58 pages, and is divided into groups dealing with hygienic aspects, conditioning of air for industrial and mechanical purposes, humidity, air-filters, air-washers and air cooling and temperature regulation. (Pittsburgh, Carnegie Library.)

The "Proceedings" of the twelfth annual meeting of the National Lime Manufacturers' Association, held in New York City Feb. 4 and 5, 1914, have now appeared in printed form. They form a 487-page book, 6 x 9¼-in., bound in paper. The lack of an index makes it difficult to find any one paper and consequently the book can not be surveyed without difficulty. The paper used is of a very cheap grade, making the illustrations, especially the halftones, of little value. (Chicago National Lime Manufacturers' Association, Secretary, Fred K. Irvine.)

A compilation of rates for gas, electric and water utilities in the State of Minnesota has been prepared by Gerhard A. Gesell, assistant professor of economics at the University of Minnesota, and issued as "Current Problems — Number 3" by the Municipal Reference Bureau of the General Extension Division at the university. The bulletin contains 254 pages of statistical matter relative to plants throughout the State—population of city or village, type of plant, details of service and schedule of price charges. (Minneapolis, University of Minnesota.)

The Educational Bureau of the Paint Manufacturers' Association of the United States, with headquarters at Philadelphia, has recently issued Bulletin 46 containing reprints of twenty-eight circulars on paint. The booklet contains 110 pages. A study of these circulars will enable consumers to make an intelligent selection of paints for the preservation of different types of structural materials, and will aid the painter in many of his problems. The last pages contain a list of bulletins and some of the articles issued during the last seven years. The typographical dress of the bulletin is excellent and the illustrations very good. (Philadelphia, Paint Manufacturers' Association of the United States.)

"Water Resources of Illinois" is the title of a 400-page, 6 x 9-in. book written by A. H. Horton, hydraulic engineer, U. S. Geological Survey. The book is issued by the Rivers and Lakes Commission of the State of Illinois and has been prepared in cooperation with the U. S. Geological Survey. There are seven main subdivisions, dealing with stream-flow data, precipitation, evaporation, profiles, undeveloped water power, storage, and gazetteer and drainage areas. The section dealing with stream-flow data contains a chapter for each river. At the end of the book there is an appendix in two parts, the first dealng with developed water power and the other with present status of drainage. (Springfield, Ill., Rivers and Lakes Commission.)

The reports of the Water Supply Commission of Pennsylvania for 1910 to 1912, inclusive, have recently been issued in two bound volumes. The first contains the reports of 1910 and 1911 and has 945 pages, all but 9 pages of which are given to the report of 1911, which is very extensive and is divided into several parts—water power, encroachments, Pymatuning Swamp, Austin dam failure, dam investigations, flood prevention, defunct water charters, discharge of Pennsylvania streams and an appendix dealing with stream-flow data in the Delaware, Susquehanna, Potomac and Ohio basins. Several tables are to be found showing incorporation of water companies and location of gaging stations.

The report for 1912 contains 317 pages. It is divided into two chapters—the general report and failures and partial failures of dams in Pennsylvania. The first chapter deals with water and water-power companies incorporated during 1912; stream encroachments and stream gaging; examination of dams; defective dams; investigation of water resources; conditions in re-approval of merger of Clarion River Power Company, and the Pymatuning Swamp investigation. Chapter 2 describes the failure or partial failures of the following dams: Austin, Brookville Water Company, Clover Run, Fort Pitt, Green Lick Run, Hosfeld, Kaufman Run, Ketner, Kittaning Point, Lake Leigh, Latrobe Water Company, Lebanon City, Macdonalton, North Strabane Water Company, Oakford Park and South Fork. Two appendices end the book, one on the Pymatuning reservoir project and the other on stream-discharge records for 1912. (Harrisburg, Pa., Water Supply Commission.)

The U. S. Geological Survey has recently issued the following papers: Water-Supply Paper 326—375 pages—"Surface Water Supply of the United States, 1912, Part VI, Missouri River Basin," by W. A. Lamb, Robert Follansbee and H. D. Padgett; Water Supply Paper 329—238 pages—"Surface Water Supply of the United States, 1912, Part IX, Colorado River Basin," by Robert Follansbee, E. A. Porter and H. D. Padgett; Water Supply Paper 344—200 pages, 17 inserted maps with profiles of the river, 28 inserted diagrams and plans of power developments—"Deschutes River, Oregon, and Its Utilization," by F. F. Henshaw, John H. Lewis and E. J. McCaustland; Water Supply Paper 347—12 pages and 37 inserted maps with profiles—"Profile Surveys in Snake River Basin, Idaho," by R. B. Marshall; Water Supply Paper 340-D—pages 43 to 52—"Stream-Gaging Stations and Publications Relating to Water Resources, 1885-1913, Part IV, St. Lawrence River Basin," compiled by B. D. Wood; Water Supply Paper 340-E—pages 53 to 61—"Stream-Gaging Stations and Publications Relating to Water Resources, 1885-1913, Part V, Hudson Bay and Upper Mississippi River Drainage Basins," compiled by B. D. Wood; Bulletin 561—42 pages—"Results of Spirit Leveling in Hawaii 1910 to 1913," by R. B. Marshall, and Bulletin 562—68 pages —"Results of Spirit Leveling in Virginia 1900 to 1913," by R. B. Marshall. (Washington, Government Printing Office.)

A Manual of Mechanical Drawing. By John Handsley Dales, Consulting Engineer, formerly Head of the Engineering Department in Gradford Technical College. Cloth, 6 x 8 in.; 181 pages; 55 illustrations. New York, G. P. Putnam's Sons. 75 cents.

The first four chapters of this manual are devoted to a thorough description of drawing instruments and their use. Halftones from photographs are used to illustrate this portion of the text. Chapter 5 is a brief discussion of free-hand lettering. Chapter 6 contains a graded series of practice sheets for ruling pen and compass. Chapter 7 includes a number of plates for conventional details and simple machine parts, and chapter 8 includes a complete set of plates for an 8-in. screw-cutting lathe. Each plate is accompanied by a page of instruction in the text.

As the principal aim of the book is to encourage neatness and accuracy in the execution of a drawing, the book may be considered a very good one for such a purpose.

Export Trade Directory. Fourth Edition. Compiled under the Supervision of the Editor of the "American Exporter." Cloth, 6 x 9 in., 370 pages. New York, the American Exporter. Price, $3.

This book is divided into the following parts: Foreign buying agencies in the United States; manufacturers' export agents, managers of export departments and export brokers (separate list for New York City and for cities other than New York);

New York bankers handling foreign exchange; foreign exchange dealers and brokers in New York City; marine insurance companies in New York City; foreign freight forwarders; some export trucking companies in New York City; steamship services to foreign ports; consuls of foreign countries in the United States; American consulates in foreign countries; associations for the promotion of export trade. Among the valuable classifications are those showing the products exported by various firms. These are classified under the article itself, so that, for example, if one wishes to know names of exporters of cement he need only look under that heading. This classification might, with advantage, be made more complete.

MACHINE DRAWING. By Charles L. Griffen, S. B., Assistant Engineer, The Solvay Process Company, and C. C. Adams, B. S., Switchboard Engineer with General Electric Company. Cloth, 271 pages; 121 illustrations. Chicago, American Technical Society.

The subject matter of this book is divided into three parts: Part I, on working drawings, takes up a brief discussion of lines, views, sections, shade lines, dimensions, screw threads, bolts, nuts, pencil drawing, tracing and blue printing. A large number of illustrative detail drawings are given and their principal features discussed. Some of these parts are as follows: Cranks, bell cranks, rocker arms and pins, link studs, connecting rods, gears, cylinder heads, shafts and bearings.

Part II, on mechanism drawing, considers the helix, screw threads, cams, belting and gears. The methods of laying out different types of cams are given, with illustrative plates for the use of the students.

Part III, is subdivided into two sections, A and B, and considers working shop drawings. Section A is a thorough discussion of the working drawings, both detail and assembly, for a duplex pump; section B is a thorough discussion of those for a direct-current generator.

The work is intended for use as a text for self-study. Throughout the text the illustrations used are first class and the discussion full in every detail. The arrangement is excellent and the work is very skilfully handled.

MUNICIPAL CHARTERS. By Nathan Matthews, former Mayor of Boston. Buckram, 6 x 9 in.; 203 pages. Cambridge, Mass., Harvard University Press. $2 net.

Taking as his thesis that while this nation devised an admirable plan of National or Federal Government, it has failed deplorably in the administration of cities, chiefly on account of the adoption of a type of charter unsuited to the administration of large communities upon the basis of popular suffrage, Mr. Matthews has prepared a work of great value to that increasing number of city officials and public spirited citizens who are addressing themselves to the task of charter making and revision. His two opening chapters, on the general features of the various types of American muncipal charters, are very interesting. They present an analysis of the accepted "mayor and large council" plan of government and an explanation of the reasons for the adoption of the small council type, and subsequently of the commission government form. In his judgment the type of charter best adapted to American conditions is the responsible-executive type, with a single small legislative board or council. He considers the commission form of charter a great improvement over the older form of large council and mayor, but objects to it because it fails to concentrate the intelligence of the entire electorate upon the filling of a single office and omits the check upon extravagance which is furnished by the veto power of the mayor under a charter of the responsible-executive type. These positions are fully explained and discussed.

The detailed discussion of charter provisions is grouped under the following heads: Political features, such as the suffrage and methods of election; relations of the municipality to the State; relations with public service corporations; administrative provisions, such as modes of appointment and organization of departments; appropriations, taxes and loans; handling of contract work; accounts and reports, and, finally, the management of water, gas and similar municipal enterprises. Charter drafts are given for the responsible-executive type and for the commission form of charter.

SURVEYING MANUAL. By Howard Chapin Ives, Professor of Railroad Engineering, Worcester Polytechnic Institute. Leather, 4½ x 7 in.; 296 pages; 56 illustrations. New York, John Wiley & Sons, Inc. $2.25.

(Reviewed by A. F. Comstock, Associate in Railway Engineering, University of Illinois, Urbana.)

This pocket manual is designed for the use of first-year students in surveying, especially for other than civil-engineering students. Although the preface contains no mention of the resemblance in text between this volume and the one entitled "Problems in Surveying....", issued in 1906 under the joint authorship of Mr. Ives and Harold Ezra Hilts, those who are familiar with the former volume will be interested in knowing that the framework of the present volume is modeled after the 1906 edition. The title has been changed, the scope slightly broadened and the text revised and somewhat enlarged (making in all a 40-page increase). A number of problems have also been added and others omitted, while six tables aggregating 100 pages have been introduced. Nevertheless, the total number of problems, together with their general method of treatment, remain unchanged; while a majority of the fifty-one individual problems are essentially the same as in the previous edition. The principal change in text, and the one which will probably be most appreciated, consists of prefacing the problems of each chapter with a description of the instruments involved, with directions for their adjustment. Altogether these several changes have combined to make the book much more usable than the previous one.

A systematic plan has been adhered to in the text. Following the description of the instrument at the beginning of a chapter are the directions for its adjustment, then come several problems illustrating the uses of the particular instrument, accompanied usually by a partial page of sample field notes reproduced to natural size. The general scheme underlying the problems has been to state the problem, mention the equipment required, and then give directions as to methods of procedure, computations, and form of notes.

Altogether there are fourteen chapters or 185 pages in the text, including 30 pages of sample field notes. The chain, tape, level, compass, transit, plane table, sextant, aneroid barometer and planimeter are taken up in the order stated. Railroad curves are given ten pages in chapter 9. Mining surveying and hydrographic surveying have been excluded. The set of general instructions and "don'ts" for handling instruments in chapter 1 are timely and to the point. The tables are sufficient for the more common work in surveying, and tend to make the book self-contained. Conciseness is apparent throughout the text, while clearness has not been sacrificed. For elementary purposes the scope is ample. The book is of a popular size and weight for pocket use, and is excellently bound.

CONCRETE-STEEL CONSTRUCTION—PART I. BUILDINGS. By Henry T. Eddy, Professor of Mathematics and Mechanics, College of Engineering, and Dean of the Graduate School, Emeritus, University of Minnesota, and C. A. P. Turner, Consulting Engineer. Cloth, 6½ x 9 in.; 438 pages; 99 illustrations. Minneapolis, C. A. P. Turner. $20 net.

(Reviewed by F. H. Constant, Professor of Civil Engineering, Princeton, University, Princeton, N. J.)

When Dr. H. T. Eddy's little book of 104 pages, entitled "The Theory of the Flexure and Strength of Rectangular Flat Plates applied to Reinforced Concrete Floor Slabs," appeared in 1913 it was stated in the preface that it was to be an advance chapter or two of a more comprehensive treatise on concrete-steel construction. This expectation has been fully realized in this somewhat voluminous treatise of 438 pages, written jointly by Eddy and Turner. The earlier book on flat slabs, which was reviewed at length in the Engineering Record of March 14, 1914, page 319, now forms, with slightly any change, chapters 5 and 6 of the present work. Some numerical errors which were pointed out in the review have been corrected, some of the matter has been rearranged and eight or ten pages of new material have been added. The theoretical treatment is essentially unchanged and forms the heart of the present work.

The new treatise is unique in being the joint product of a mathematical investigator of the highest order in the realm of structural mechanics, and of a practical engineer of wide experience in this special field. Such a book can not fail to be of interest to the engineering public, and especially to investigators who are interested in the mechanical properties of this form of construction.

The book may be said to speak to two widely separated classes of readers—to mature investigators with minds trained to follow intricate mechanical relationships, who will find a great amount of solid matter and food for thought, and who, if they may not agree with all the mathematical conclusions of the author, will find their own mental processes quickened and ideas clarified; and, on the other hand, to practical builders, with or without much theoretical training, who will find in the descriptive portions much practical information and good advice.

The theoretical treatment has been greatly expanded, and the additional part is more general and not so apparently and exclusively applicable solely to the mushroom type of slab. In this regard it has gained greatly in breadth. Neither is it so formidably mathematical, but is, rather, a philosophical exposition of the complex mechanical relations which exist between strain and stress. The authors had at their command a vast amount of experimental data upon which their reasoning is founded, and by which the accuracy of their conclusions are constantly tested.

The theoretical part of the book is contained in chapters 3 to 7 inclusive, and the newer chapters not only cover a wide range of reinforced-concrete mechanics, but also assist in clearing up some of the reader's difficulties in the older chapters 5 and 6. This part of the book is not for the novice or the beginning student, notwithstanding the subtitle, "A Treatise upon the Elementary Principles of Design and Execution of Reinforced Concrete Work in Buildings."

Chapter 3 is on beams and chapter 4 on beam action and slab action compared through the application of the laws of bond shear and the theory of work. Chapter 5 covers the theory of the flat slab and chapter 6, stresses and deflections numerically computed from the formulæ and verified by tests. This includes comparative tests of the Norcross and mushroom slabs and also some valuable sidelights upon extensometer methods. Chapter 7 on moments in two-way and four-way flat slabs contains a simple approximate theory for these two forms of slabs with a comparison of the relative weights of steel; also a mathematical investigation of some degree of complexity of panels reinforced unequally lengthwise and crosswise. It discusses mathematically the case of the slab with rectangular panels supported on beams or walls. Hollow-tile and concrete construction for floors, and slabs reinforced with expanded metal, receive brief consideration.

Of the practical part of the book, chapters 1 and 2 are general and descriptive of concrete and reinforced-concrete construction. Chapter 8 covers columns. Of special interest is a review of some large-size tests conducted at Phoenixville, in which the maximum load reached was 1,360,000 lb. The authors' warning against too great reliance on longitudinal reinforcement not properly stiffened by closely spaced ties or bands is timely. The authors lean toward the use of Consideres' formula and justify it on the ground that the increased resistance of the core from the lateral pressure of the hooping should be accounted for in the formula in terms of the volume of the hooping.

Chapter 9 is on foundations and includes column footings and concrete piles. Chapter 10 contains some valuable data on costs taken from long building experience. Chapter 11 relates to fireproofing, and chapter 12 to the protection of steel from corrosion. Chapter 13 is on concrete-floor finish, and chapter 14 on the artistic and commercially practicable concrete surface finishes. The latter chapter includes several excellent halftone plates illustrating various kinds of surfaces. The book closes with a short general chapter on miscellaneous matters.

The book is a distinct contribution to the field of reinforced-concrete research, especially to the flat-slab theory. It is probably the most searching study of the mechanics of this form of construction that has yet been published, while the large amount of experimental data at the command of the authors enabled them to supply the empirical quantities needful to make their formulæ of practical value.

THE FIRST NIGHT LOCKAGE at the Pacific locks of the Panama Canal took place Dec. 7, 1914, when the Limari passed through Pedro Miguel and Miraflores locks. Details are given in the "Canal Record." The passage of Pedro Miguel lock required 25 min. and that of Miraflores locks 1 hr. 12 min.

Letters to the Editor

Bottom-Chord Members of the Hell Gate Bridge

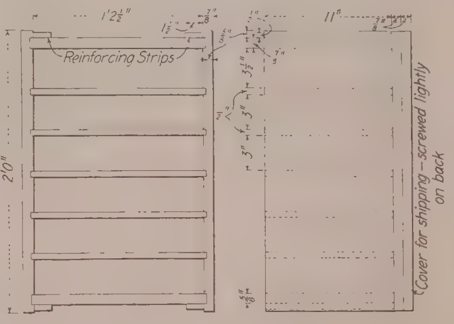
SIR: I beg to call your attention to an erroneous statement in my article on "Steel Structural Engineering" in your issue of Jan. 2, to the effect that the heavy bottom-chord members of the Hell Gate Bridge will have to be shipped in longitudinal halves. This statement applied to these members as originally designed, described in the Engineering Record of Sept. 3, 1910, page 258, but it does not apply to these members as redesigned, and described in the Engineering Record of Sept. 12, 1914, page 298, and that of Dec. 26, 1914, page 684.

EDGAR MARBURG.

Philadelphia.

Inexpensive Shelves for Current Technical Literature

SIR: Some philosopher once said that knowledge is of two kinds: One is that which the individual has in absolute possession and over which he has definite control; the other is that which he has put away in such a place that he knows where to find it at will. The multiplication table is an example of the former; logarithms, of the latter.



DETAILS OF SHELVES

For those of us who are employees and therefore of necessity have very limited time at our disposal for reading current engineering literature, it becomes quite a problem to know just how to make the best use of that of special interest in our field. Miss Krause's suggestions on the classification and use of current technical literature (see the Engineering Record of April 25, 1914, page 479) apply very well to corporations and consulting engineers firmly established in private practice; but the private employee, whose length of service in any one position rests with the good nature and whim of an immediate and important superior, will need to have his plans made so that he can move his library at an expense that is not prohibitory.

I have been a regular subscriber and fairly consistent reader of the Engineering Record ever since my senior year in the university. As the years passed my files became a greater nuisance every time I wanted to move. Books and magazines required extra strong boxes for shipping, and I found it quite a task to get my magazine files together for shipment. On unpacking again I found I had no place for them.

After binding four volumes of my files I decided that I would rather be the owner of two continuous files of unbound magazines than one of bound magazines. For the engineer in a permanent position who can afford it, binding, of course, is to be preferred.

For the benefit of those who have had similar experiences with their files of current engineering literature I submit my solution as inexpensive, effective and in many respects quite satisfactory. About every two or three months I strip off all advertisements and then bind the numbers together by months. The four or five numbers of the month, bound within the cover of the first number, now occupy about as much space as a single number when it comes from the publishers.

Bound in this way the fifty-two numbers or the two volumes for the year occupy a space of about 2½ in. in thickness. For these two volumes I have a separate compartment 3 in. high in a strong box containing six similar compartments, one above the other, the top compartment being ½ in. higher so it can take the volume of indexes for the twelve volumes in the case. If the "Current News" is to be included the compartments need to be ½ in. higher.

The shelves made in accordance with the dimensions of the accompanying figure furnish proper clearances for ready insertion and easy removal of the copies of the Engineering Record bound as described above. The bill of material for one case of shelves is given in the table. Made of well-seasoned white pine and containing twelve volumes and index bound together by months as described above, the case of shelves weighs about 120 lb.

BILL OF MATERIAL FOR ONE CASE OF SHELVES

2 Sides	⅞ x 11 x 2 ft. 0 in.
2 Ends	⅞ x 11 x 1 ft. 3 in.
4 Covers	⅞ x 8 x 2 ft. 0 in.
5 Shelves	½ x 11 x 1 ft. 3 in.
4 Strips	½ x 1½ x 0 ft. 11 in.
3 dozen 1½-in. wood screws.	
1 dozen 1¼-in. wood screws.	

Chicago. JOHN BERG.

Pearl Harbor Drydock

SIR: Referring to the "Current News" of your issue of Dec. 5, 1914, page 276, you have a news item under "Contract Closed for Construction of Pearl Harbor Drydock." I do not know the source of your information, but the concluding statement is at least misleading, if not incorrect. The general method of construction now finally adopted, namely, of building the drydock in sections by the pontoon or floating-caisson system, was originally recommended by me and not by Mr. Noble. After visiting Pearl Harbor, I reported on this work on July 1, 1913, and recommended the adoption of such a method for the construction of the drydock.

A typical and general development of the scheme recommended in the report of July 1, with outline plans, was submitted Sept. 26 of the same year. Mr. Noble was called into the matter some time in August and reported, I believe, late in October. He had been furnished with my report, with its recommendation of July 1, and, also, the development of the pontoon scheme of Sept. 26. He suggested the adoption of this plan of construction recommended by me, developing it along somewhat different lines, but adhering to the main principles. The plan, as finally developed and now adopted, is that of constructing the drydock in sections by floating into position and sinking these. It was worked up in its present form under the direction of the chief of the Bureau of Yards and Docks, Civil Engineer H. R. Stanford, U. S. N., the plans and all the details being the result of collaboration by this official with L. M. Cox, E. R. Gaylor and myself, all of the Corps of Civil Engineers, U. S. N., and bear a closer resemblance to the original details proposed on July 1 and Sept. 26 than to the changes suggested by Mr. Noble.

I do not know of any examinations or reports on this work by officers of the Corps of Engineers of the United States Army, and presume you have misunderstood this and refer to the Corps of Civil Engineers, United States Navy, in justice to which corps, of which I am a member, I am sending you the above correct information.

F. R. Harris,
Public Works Department, Navy Yard.
New York City.

Apathy Toward South American Trade

Sir: The Fidelity Trust Company, of this city, has chartered the steamer Finland to make what is called the "Link-the-Americas Cruise to South America." The vessel is to leave Baltimore Jan. 28, 1915, and return May 11, stopping at twenty cities in the West Indies and South America. The entire trip includes 106 days, of which fifty-four will be spent on shore. Stops at the cities will vary from ten hours to eight days, depending on the size of the city visited. It has been estimated that the cost per representative, of this trip, including salary for approximately four months, would be about $4,000, this being based upon an inside stateroom costing $1,300 for the trip.

Thinking that perchance there would be four firms who handle engineering machinery, etc., who would be interested in having a representative make this trip, I took up the matter with sixty-one firms, hoping to arrange with four of them to represent them at a cost of $1,000 each, thereby saving each firm approximately $3,000 from the amount it would cost to send an exclusive representative. I also figured that one man representing four allied but not competitive lines, would have a better chance of getting in touch with the proper people in these South American cities than would four men trying to accomplish the same end.

Strange to relate, instead of being able to obtain four firms, I was unable to obtain a single firm, and out of the sixty-one with which I communicated, seventeen stated that they were already represented in South America in one way or another, thirty-four stated that they did not care to go after South American business and ten did not even answer my letters.

While it is well known among business men that South America may not be, at present, in position to buy and pay for supplies, nevertheless with the output of Europe absolutely cut off, South America will have to look to the United States for its manufactured goods of all kinds, and the firms who go after this business now and make connections with the South Americans will be the ones which will later reap the business of that country.

Furthermore, now that the National City Bank of New York has established and is establishing branches in South America, and that other banking institutions are looking forward to making very close connections with the South American financial institutions, it should not be very long before the finances of South America are in an improved condition and the South Americans in position to do business with the United States in a manner satisfactory to all concerned.

There are several things that should be borne in mind in connection with the South American trade. First, do we of the United States want some of this business? Second, if so, the first man in a new field always has the advantage, even if he is merely reconnoitering. Third, a trade surveyor should be sent ahead to run the commercial line.

Bearing all these things in mind it seems very strange that out of sixty-one firms forty-four who are among the largest in their respective lines, should be so little interested in South American trade as is evidenced by my experience above mentioned.

Layton F. Smith,
Engineer-Architect.
Baltimore.

Eccentric Rivet Connections

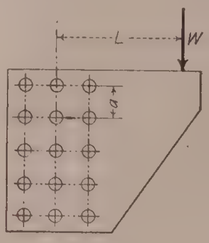


Fig. 1

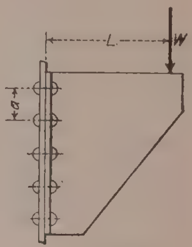


Fig. 2

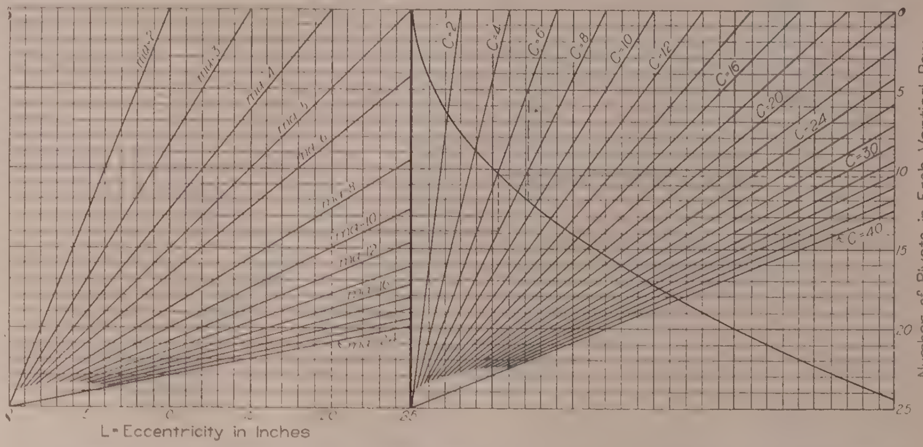


DIAGRAM FOR QUICK SOLUTION OF NUMBER OF RIVETS IN EITHER OF TWO TYPES OF ECCENTRIC CONNECTIONS

Sir: The design of eccentric riveted connections by the method now in common use is long and tedious, requiring a series of trials until a proper arrangement is selected. In drafting rooms detailing steelwork, especially office-building work, eccentric connections are very frequently encountered and a large amount of the draftsmen's time is consumed in designing them. The accompanying diagram offers a quick solution of the required number of rivets in the common eccentric connections. By its use the work of designing such connections is reduced so that the time required is about the same as for simple connections. For all ordinary cases the results obtained by the use of the diagram are correct to the nearest rivet.

Let a = distance between rivets in each vertical row; m, number of vertical rows; L, eccentricity; W, load; C, W divided by rivet value. In the accompanying diagram Figs. 1 and 2 show the two types of joints to be considered.

The following is the procedure for a joint of the type shown in Fig. 1: Multiply m by a, mentally. Divide W by the rivet value, obtaining C. In the large diagram start at the bottom with the vertical line corresponding to the given value of L, and follow this up to an intersection with the correct ma line; then project this point horizontally to the proper C line, vertically from there to the curve, and horizontally to the right to a reading of the number of rivets required in each vertical row. As an example, given $a = 3$ in., $m = 3$, $L = 20$ in., and $C = 8$, the number of rivets in each vertical row, as indicated by the dotted line, is found to be eleven.

In a joint of the type shown in Fig. 2, m is taken as unity, hence $ma = a$; also, C = W divided by the product of the rivet value and the number of vertical rows. With these values of ma and C the procedure is the same as for the type in Fig. 1. As an example, given $W = 48{,}000$ lb., $L = 12$ in. and $a = 3$ in. Assume that the plate is attached by two lines of rivets, the strength of each rivet being 4000 lb. Then $ma = 3$, $C = 6$ and the required number of rivets in each row is found to be twelve. The path of this determination is indicated by the dot-and-dash line.

Charles D. Conklin, Jr.,
Civil and Structural Engineer.
Cheltenham, Pa.

A New Railroad Ferry, said to be the largest of its kind in the work, has just been built and put in service on the line of the Southern Pacific Company between Port Costa and Benicia, Cal. The Contra Costa, as the new boat was christened, will replace the Solano until repairs and alterations have been made on the latter. Double slips have been provided so that both boats can be used simultaneously in handling Exposition traffic. The Contra Costa, which was built at the Oakland shipyards of the Southern Pacific Company, has a steel hull 433 ft. long and 116 ft. wide. It is provided with four tracks spaced 12 ft. on centers, and can accommodate two locomotives and either 36 freight or 24 passenger cars.

HINTS FOR THE CONTRACTOR

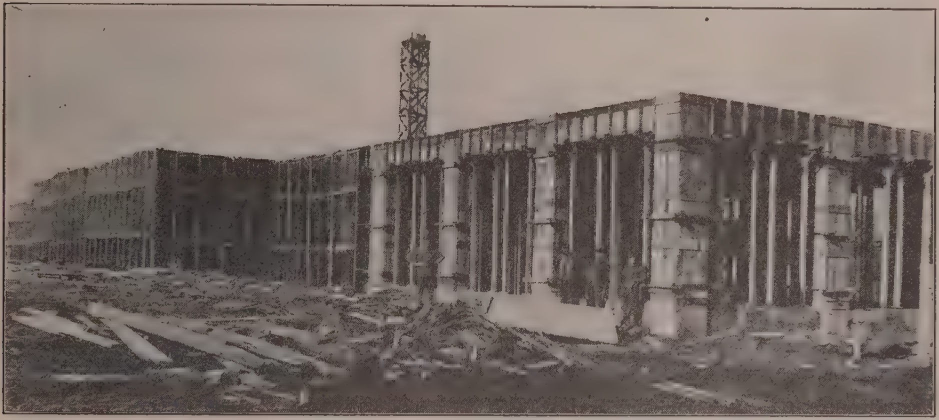
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Paper-Covered Frames for Cold Weather Concreting

By A. A. LANE
Youngstown, Ohio

PAPER-COVERED frames, costing 2.1 cents per square foot in place, were used to enclose a 46 x 212-ft., two-story reinforced-concrete building poured during freezing weather for the National Tire & Rubber Company at Palestine, Ohio. The frames were 6 ft. wide and 14 ft. long and were made of three longitudinal strips and three cross strips of 7/8 x 3-in. lumber. The covering was a heavy waterproof paper known as Birds' Neponsit.



PAPER-COVERED FRAMES PROTECT CONCRETE POURED DURING FREEZING WEATHER

In making the frames it was only necessary to lay down the three longitudinals and nail the three cross pieces in place. The paper was then rolled out on these in two strips each 3 ft. wide and secured by tacking lath to the frame with shingle nails. The open panels in the frame measured 3 x 7 ft., and to give additional support to the paper lath was placed inside and outside of it across the center of each of these panels. The paper was allowed to extend 18 in. at each end of the frame, these loose ends being used to close up the openings at the top and bottom after the frames were put in place on the building. To support the frames on the forms of the building 1 x 4-in girts were nailed to the column bands. Three lines of girts were used.

The frames were rapidly erected and the flap of paper on the top end was nailed to the top edge of the outside lintel form. This made the enclosure tight and allowed hot air from salamanders to protect the outside of lintel beams from freezing, this being the point of greatest danger. The flap at the bottom was also secured against the foundation wall.

The gravel used in the concrete was heated for several days before using. Steam pipe was run to the gravel pile, at the end of which were two 10-ft. sections of hose, each of these terminating in a 1¼-in. well-drive point. The water for concrete was heated by a steam jet in a 6 x 6-ft. sheet-iron tank to about 180 deg. The sand was not heated. The concrete when poured was at a temperature ranging from 55 to 70 deg.

After the concrete was poured salamanders were fired for four days and nights. The concrete did not freeze at any point although the temperature dropped to 20 deg. at night after pouring. By the use of similar paper covered frames to cover over the concrete it is believed that the work could have been carried on at much lower temperature.

The work was done under the supervision of the author as engineer for the Security Construction Company, of Youngstown, Ohio.

Steam Shovel Removes Old Pavement Cheaply

IN removing old pavement in Ogden, Utah, preparatory to laying eight blocks of asphalt, the contractor facilitated the usual procedure with hand sledges, plows or scarifiers by substituting a steam shovel. The photograph shows the shovel, a Bucyrus 14-B with which the contractor had just completed the excavation of the basement for the Dee-Ecclees Building, tearing up a 10 to 12-in. pavement with a concrete base. Although progress was impeded by the necessity of loading the wagons on the street car tracks, the usual rate per day was one block, 600 ft. long and 20 ft. wide between the curb and cobbles, laid along the street car tracks. The labor cost per day given by the contractor, G. A. Heman, was as follows: One steam shovel engineer, $7: one fireman, $3; two pitmen at $2.50 each; five teams at $5 each, and one foreman $4.50. The cost of ripping up 1400 sq. yd. of base was accomplished for approximately one-tenth of the estimated cost.

STEAM SHOVEL RIPS UP PAVEMENT AT ONE-TENTH OF ESTIMATED COST

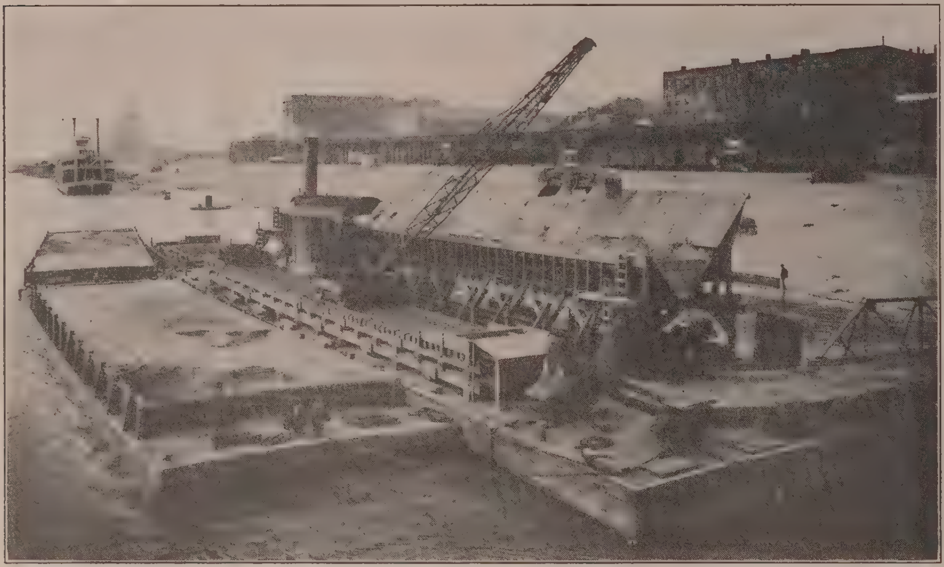
Feeding the Mixer by Small Railway Cars

AN article on page 621 of the Engineering Record of Dec. 5, 1914, described the application of a narrow-gage railway equipment to hauling materials for a concrete road between Whaleyville and Parsonburg, Md. The advantages of the equipment for hauling over the loose sand which is the natural soil of the region suggested a further application to the contractor, the M. J. McNerney Construction Company, of Canton, Pa. If wheelbarrows had been used in carrying aggregates and cement from stock piles to mixer it would have been necessary to use running plank. A three-way frog and 100 ft. of straight track in 5 and 10-ft. lengths—all 15-lb. 18-in. track—were combined into a miniature tramway, over which two revolving ½-yd. end-dump cars were run. A longitudinal plate divided the car body, one compartment being used for stone and the other, half its size, for sand. These cars were filled at the piles, revolved 180 deg., and pushed by hand directly into the scoop feeder of the mixer, where they were automatically tripped. Two bags of cement were added at the mixer, making a complete 1 : 2 : 4 batch.

The track was the conception of M. J. McNerney, general manager of the construction company, and was built by the Orenstein-Arthur Koppel Company, of Chicago. The special three-way piece was light enough so that three men could handle it when the mixer was moved. The length of a movement was between 20 and 30 ft. and the average time required was 2 min. Frank H. O'Rourke was superintendent of construction.

Floating Plant for Unloading Sand and Gravel

OWING to the excessive fluctuations of the Mississippi River the unloading of material directly from barge to wagon is a somewhat uncertain process. To obviate this difficulty the Union Sand & Material Company, of St. Louis, built a floating unloading plant at the foot of Walnut street. The plant is composed of a 40 x 150-ft wharfboat with a hold 6 ft. deep, which is anchored to the levee bank nearby. At each end of the wharfboat two steel truss bridges connect the shore and the barge so that teams may avoid turning. The bins for holding material have recently been rearranged to make them wide enough to accommodate automobile trucks. Loaded material scows are run alongside of the loading barge. The sand or gravel is lifted into the elevated hopper by a locomotive crane running on a short trestle on the barge. Material is dumped directly from the hopper into the wagons.



UNLOADING SAND AT WHARFBOAT CONNECTED TO SHORE BY BRIDGES FOR TEAMS

Joint for Concrete Roads

IN order that concrete may be poured simultaneously on both sides of expansion joints in pavements, thus obviating all delay occasioned by placing the joint, a template form has been devised. This form consists of a 2-in. plank, framed on the bottom edge to the crown of the roadway and flanked along each side by pairs of 3/8 x 2-in. plates, 6 in. long. The material for the expansion joint, Elastite, is inserted between these plates, which hold it in shape. The device is fastened across the roadway at the expansion joint by means of the plank, and concrete poured on both sides of it. While the concrete is still green, the plank and the plates attached to it are pulled out, leaving the finished joint. This way of placing expansion joints is in use by the Illinois State Highway Commission on work near Harvey.

Grouting a Leaking Tunnel

BY means of grouting, a 7-ft. concrete-lined tunnel at Milwaukee, which developed cracks allowing more than 5000 gal. of water per hour to enter, was made watertight. The greater portion of the tunnel, which has walls 12 to 14 in. thick, was driven 700-ft. through quicksand about 7 years ago by the Commonwealth Power Company at an approximate depth of 55 ft. below datum. The bore carries steam pipe lines and cables. Shortly after completion there was a cave-in. After the section was repaired, serious cracks developed, causing a break at the shaft. A leakage of 5000 gal. per hour, at a pressure of more than 25 lb. per square inch developed and two large electrically-driven pumps were kept constantly working.

A contract was awarded to the Waterproofing Company of America for rendering the tunnel watertight without removing any of the cables or pipe lines. At the time the work was commenced it was found that the walls were so weak that it became necessary to strengthen certain portions with an inside layer of reinforced concrete 6 in. thick. More than 4000 bags of Portland cement in addition to large quantities of sand and waterproofing compound were grouted under air pressure through bleeders to the exterior surface of the walls. Holes were drilled in the top of the tunnel and iron pipes grouted in. The grout flowed along the exterior surface of the tunnel and formed a complete new covering. After continuous work for a period of 3½ months the tunnel was finally made watertight, without removing any of the steam lines or electric cables which interferred with the repair work.

OBSTRUCTIONS IN LEAKING TUNNEL THAT WAS MADE TIGHT BY GROUTING

Crane a Time Saver in Handling Brick and Sand

THE accompanying illustration shows an economical use to which a locomotive crane has been put in the yard of the Department of Public Works at Detroit, for handling old paving bricks. While there is nothing new in the idea of handling loaded wagons with a derrick, this application of the plant indicates a desire on the part of the management of the yard to use the equipment at hand for cutting costs. Piling bricks up in this manner by hand would be both slow and costly. Crushed stone and sand are handled to storage piles in this yard in the same way.

CRANE HANDLES WAGON-LOADS OF BRICK

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Alien Labor Law Declared Unconstitutional

Appellate Division Hands Down Opinion on Contract Clause Which Promised to Delay New York Subway Work if Enforced

The alien labor law which is incorporated as a part of all New York State contracts and which requires contractors on public works to employ none but United States citizens or those who have taken out naturalization papers was declared unconstitutional in a decision handed down, Dec. 31, by the Appellate Division. In order that a final construction of the statutes may be obtained from the highest court in the State the Public Service Commission, which is in charge of the New York subway work, will carry the case to the Court of Appeals.

All the Justices of the Appellate Division concurred in the decision, which was written by Justice Scott. It says in part: "The policy of New York has always been to welcome not only the citizens of our sister States but emigrants from abroad to equal participation in all the opportunities and advantages of its business life. If the policy indicated in the statutes now under consideration—Section 14 of the labor law—had been formulated and carried into operation half a century earlier it may be that the growth and progress of the State would not now be the subject of so much pride or so gratifying to all the people as it is now.

"We are unable to see how the public health, safety or morals can be affected by the citizenship or alienage of laborers upon the subways or upon other works of a similar character.

"It seems to be considered by all the respondents—Public Service Commissioners—that it would be incompetent for the Legislature to impose upon private persons or corporations not engaged in performing public works such restrictions as are attempted to be imposed upon the city of New York as an arm of the State."

The opinion states further that the subway is a business enterprise of the city and was not undertaken by the city as a sovereign. On this point Presiding Justice Ingraham, in an individual opinion, says:

"The city is not building these subways for the benefit of the people of the State but for the benefit of the municipal corporation and it owns such subways and they are operated not as public works but as the private property of the city. It seems clear, therefore, that even assuming that the Legislature has power to impose such an obligation upon the city of New York by limiting the prohibition to 'public works' such limitation would not apply to work of the character described in the complaint in the action. Therefore the provisions of this section of the labor law do not apply to the city of New York when building a subway or railroad as a business enterprise of the city."

Broken Pipe Empties Water Mains at Columbus

Columbus, Ohio, was without water for 3 hr. on Jan. 4 as the result of a break at 1:30 A. M. in a 36-in. main which serves as a direct feeder from the Scioto River pumping station. According to information received from Jerry O'Shaughnessy, superintendent of waterworks, the main burst 2 ft. behind the bell end of one of the pipe sections. The pipe was in newly filled ground and the break was caused by settlement of the pipe. The broken section was at one of the lowest points of the distribution system, and consequently water was drained from all the mains in the city. The water escaped into an abandoned dump and caused no particular damage, according to Mr. O'Shaughnessy. Two 36-in. valves shut off the water from the broken pipe and the pumps began working at 4:30 A. M. Jan. 4. An hour later normal pressure was restored throughout the city. The pipe was repaired by placing a sleeve around it. There was no damage to property.

Tunneling Record Again Broken at Rogers' Pass

The American rock tunneling record of 817 ft. made in the 30 days from Nov. 1 to 30 at the Rogers' Pass Tunnel of the Canadian Pacific Railway at Glacier, B. C. (see Engineering Record, Dec. 19, 1914, and Jan. 2), has been exceeded by the advance of 852 ft. in the west pioneer heading during the month of December. The material penetrated was slate containing small quartzite bands. The contractors are Foley Bros., Welch & Stewart, for whom A. C. Dennis is superintendent. Joseph Murphy and Joseph Fowler are the assistant superintendents at the east and west ends respectively.

Dr. Karl Imhoff Sends Greeting from German Trenches

Dr. Karl Imhoff, inventor of the two-story sewage settling tank which bears his name, is still alive after four months' active service in the European war. In a letter to Rudolph Hering, consulting engineer, of New York, dated Dec. 4, he writes that he is now serving as Captain of Engineers in the German Army, and sends greetings to his American friends. He left home to join the army on Aug. 2 and spent about a month at the front, first in Belgium and then in France. A severe attack of dysentery caused him to leave his battalion and spend some time in a hospital. Since then and for six weeks he had been stationed at Cleve, Germany, near the Holland border, in training a new battalion, and expected to be with his own regiment at the front after Christmas. He writes that about half of the battalion were Socialists and that all of them were enthusiastic patriots. He had never been with a better set of fellows, all of whom were both intelligent and courageous.

Dr. Spillner Killed

He also writes that Dr. Spillner, one of his associates, had fallen in battle. Dr. Spillner had been in charge of the chemical work in Essen, connected with the Imhoff tanks, and has written a number of papers on the subject.

Dr. Hering also received a letter a few days ago from David M. Watson, son of the English sanitary expert, John D. Watson, of Birmingham. David Watson left Dr. Hering's office in the middle of August to join the English army. After eight weeks of training he was put on the sanitary corps and ordered to the front. His duty was scavenging of no ordinary type—burying and reburying of the dead—and he was naturally disappointed, hoping to have been "right in the thick of it." He then was assigned to duty with Sir John Jackson, the famous contractor of war department work, at Salisbury Plain, who was erecting wooden buildings, bringing in water supplies, etc., for the temporary camps of the Colonial troops.

Progress on Quebec Bridge

At the annual meeting of the Dominion Bridge Company it was reported that 42 per cent of the steel for the new Quebec Bridge had been fabricated and 18 per cent erected. It is anticipated that the work will be finished on time and within the original cost estimates.

New York's Worst Subway Accident

Short Circuit in Manhole Results in Burning of Insulation and Production of Suffocating Smoke

The burning out of electric feeder cables in two manholes on opposite sides of the New York subway at Fifty-third Street and Broadway at 8 A. M. Jan. 6, followed by the production of dense clouds of yellow, acrid smoke, resulted in the death of one person and the prostration of 200 others. The accident is the worst in the history of New York's underground rapid transit system. Crowded trains were stalled throughout the length of the great tube, and when the lights went out a serious panic was narrowly averted. It was hours after the short circuit occurred before all of the imprisoned passengers reached the surface.

In explaining the cause of the burn-out Clifton W. Wilder, electrical engineer of the Public Service Commission, said that the trouble started when the insulation of one of the twenty or thirty cables in one of the manholes weakened and an electric arc was created. Owing to the large amount of insulating material on the cables in these manholes, a very dense smoke was created, which filled the subway at this point, and caused a considerable number of passengers on trains near these manholes to be overcome.

Owing to the destruction of the cables no evidence is left which indicates what may have caused this burn-out. It is impossible to anticipate burn-outs of this character, according to Mr. Wilder, despite the fact that every precaution is taken in the manufacture and installation of these cables.

It seems possible, he said, to take steps which will prevent the accumulation of smoke in the subway should an accident of this character occur in the future.

All the Interborough power is generated in a power house at Fifty-ninth Street and the North River. From there it is carried by high-tension feeder cables at 11,000 volts, alternating current, to various sub-stations, one of which is situated at Fifty-third Street, near Broadway. There it is converted into direct current of about 600 volts and carried on low-tension cables to the subway and is sent to the third rail. The high and low tension cables are carried separately in ducts running through the subway wall. The manholes or splicing chambers are built out from the wall of the subway, and have, besides the entrance from the street, a door leading into the subway itself. The cables are ranged on racks close together on the walls of the splicing chambers.

Normal train service was resumed at about 2 A. M. Jan. 7.

To Report Power Site Bill

Committee Gives Commerce Board Supervision of Security Issues

Revision of the Administration water-power site leasing bill, which has passed the House, was completed Jan. 6 by the Senate Lands Committee. It will be reported favorably to the Senate.

As now amended the water-power bill retains the leasing feature, but supervision of stock and bond issues of corporations operating under such leases, where the power generated will be used in more than one state, is conferred upon the Interstate Commerce Commission instead of the secretary of the interior.

The section relating to the Government's power to take over the property at expiration of a lease was amended to provide that a "severable and complete unit" of any power system may be taken over by mutual agreement if it is not desired to acquire the whole property.

The committee struck out the prohibition against the sale of more than 50 per cent of power generated under any one lease to any one concern. The bill now provides that 50 per cent of revenues from leases shall be paid directly to the state in which the project is located, the remainder to go to the Federal reclamation fund.

Seepage Develops at Cedar River Reservoir

Seattle Considers Plans for Checking Leakage Through Porous Material in Reservoir Completed December 1

Seepage has developed near the $1,500,000 Cedar River dam, just completed for the city of Seattle, Wash., as part of the new municipal water and power project. The works were placed in service about Dec. 1, and as the new reservoir filled considerable water percolated through porous material in the north bank and springs appeared in the valley ¾ mi. below the dam. The reservoir had been filled to a depth of about 50 ft., at which level the leakage was found to amount to 1 in. per hour, or the equivalent of 4,250,000 cu. ft. per day. The dam itself showed no signs of appreciable seepage, it is reported, either in the interior inspection galleries or below its toe, the seepage apparently being confined to that portion of the north bank of the reservoir within 2 mi. of the dam.

Seepage Expected by Designers

In a report prepared prior to the construction of the dam by Henry Landes, State geologist and acting president of the University of Washington, and Dean Milnor Roberts, of the same institution, it was pointed out that Cedar Lake has a disused subterranean outlet to the Snoqualmie valley. The report predicted that if any large body of water was stored behind the dam it would very likely find an outlet through this old river channel. One section of the report states that "the probabilities almost amount to a certainty that there will be a large loss from the lake by seepage around the north end of the dam unless great precautions are taken." The precautions recommended were the building of a wing dam from the north end of the main structure northeasterly toward Cedar Lake. "It may even be necessary," the report goes on to say, "to continue the curtain wall to the mountain to the north of the present lake."

Based on the foundation for this prediction and on other considerations, a commission composed of Joseph Jacobs, E. H. Baldwin and Glover F. Perrin, was retained by the city for several weeks at $150 per day each, to report on the feasibility of the project, prior to starting work. They reported against the present location of the dam. In working out designs for the project, therefore, the possibility of seepage was well known, and was taken into consideration by R. H. Thompson, then city engineer, who estimated that if a sealing process became necessary the work could be carried out by degrees in a period of about 5 years and at a cost of about $200,000. It was also possible, he thought, that a cutoff wall or wing dam might be required.

Location and Size of Leaks

Several large leaks have already been located on the lower side of the glacial dike toward the Snoqualmie basin, and a survey of the watershed below is being made to ascertain if there are others still farther away. About 1½ mi. north of the north end of the dam a leak appeared on Dec. 3, and another at Moncton, 2 mi. northwest of the dam appeared Dec. 8. The largest of all, however, appeared Dec. 1 at a point much closer to the dam and when gaged with a weir on Dec. 7 its flow amounted to 26.8 sec.-ft.

Stream gages which have been read for 3 yr. are located below the newly developed leaks and their readings since the new reservoir was put in use indicate a volume of flow at the present time of three or four times the normal value. Three of these weirs showed no undue increase until Dec. 10, when increased flows of 50, 225 and 165 per cent respectively were recorded. The largest leak showed a rapid increase from Dec. 3 to Dec. 7, after which the flow gradually decreased. A point of interest is that after all the weir readings began to decrease, the reservoir level continued to drop at the same rate. No rainfall has been recorded between Dec. 3 and Dec. 15.

Plans for Stopping Leaks

The present city engineer, A. H. Dimock, expects to start work at once on the stoppage of the leaks by sluicing clay and other fine material from the hillside above the stream onto the porous bank. While this is in progress, experiments are to be made on the bank through which the water is escaping, with a view to constructing a wing dam or curtain wall from the north end of the dam about 1500 ft. toward the old timber dam at the mouth of Cedar Lake. This curtain wall would be carried down below the gravel formation, and would be calculated to withstand full hydrostatic pressure.

Ottawa Wins Point in Water Supply Controversy

Judge Decides that Provincial Board of Health Exceeded its Powers in Disapproving Mechanically Filtered River Supply

Judge Middleton, in a judgment rendered at Toronto last week, declared that the Provincial Board of Health exceeded its powers in rejecting Ottawa's $2,000,000 water supply project involving mechanically filtered water from the Ottawa River and substituting therefor Sir Alexander Binnie's $8,000,000 Thirty-one Mile Lake project. By the judgment of the court the city of Ottawa secured a mandamus against the order of the Provincial Board of Health which would have compelled the city to construct the Thirty-one Mile Lake works.

The filtered Ottawa River plan, for which detailed drawings and specifications were prepared by the firm of Hazen & Whipple of New York City, under the direction of Weston E. Fuller of that firm, had been approved by the taxpayers at a general election in preference to the more expensive Thirty-one Mile Lake plan. The rejection by the board of the Ottawa River plan was based, apparently, upon a misconception of the functions of the filters and particularly of the sterilizing agent which it was proposed to use as an after treatment, if required.

The court holds that the Board of Health has arbitrarily exceeded its powers and that its order given to the taxpayers of Ottawa cannot stand. The board was simply empowered to approve or disapprove of the plans submitted and had not the power to make a choice from the two after both had already received approval.

"It is quite apparent," said Judge Middleton, "that the board has acted upon the assumption that it was justified in refusing to approve of the plan because the scheme propounded by Mr. Currie (essentially the Hazen filtered river water plan) did not meet with the approval of the board. It is manifestly a matter of vital importance that the city of Ottawa should secure a proper water supply. Whether it is necessary to spend $2,000,000 or $8,000,000 for that purpose must be determined by those upon whom the responsibility is placed.

"The Legislature submitted the choice of the scheme to the ratepayers. They chose the less expensive scheme. By this act the Legislature has entrusted the Board of Health with certain duties and I must determine upon the construction of the act whether the board was given power to review the action of the ratepayers and to disallow the scheme of which the ratepayers have expressed their approval or whether the board was only given the more limited power of dealing with plans and specifications submitted for the carrying out of the approved scheme.

"It seems to be clear that the board has gone beyond what was referred to it by the statutes when it assumed, as it undoubtedly has, to criticize and reject the engineers' report upon the source of water supply. If it was intended that the board should have the power to strike at the root of the whole scheme by rejecting the river as the source of water supply, it is hardly conceivable that the municipality would have been directed to prepare and submit to the board detailed plans and specifications which, I am told by counsel have cost the municipality upward of $30,000.

"I think the board has failed to discharge the precise duties imposed upon it by the statutes and that the mandamus should be granted."

Conservation and Highway Changes Urged by Governor Whitman

In his first message to the Legislature Governor Whitman of New York takes a strong stand in favor of technically qualified men for the heads of divisions under the Conservation Commission, and urges a non-partisan commission of three members to take charge of highway work, instead of the present single head.

As to the Conservation Commission, which has supervision, among other things, of inland waters, water storage, hydroelectric developments and dam construction, he also recommends that the important subordinates be trained experts, appointed under the civil-service law.

The terms of the three highway commissioners, the governor proposes, shall be six years, the initial appointees, however, serving for two, four and six years. Under such an arrangement each subsequent administration—if the plan "stays put," which does not seem likely in New York—could appoint only one member, unless death or resignation created unexpected vacancies. Not more than two of the commissioners could be from one party. In explanation of his attitude on the organization of the highway department, the governor points out that the department, because of the large number of employees and the amount of its expenditures, is regarded as the greatest spoils asset of the party in power, and that this view cannot well prevail if it is headed by a non-partisan commission. Theoretically the governor believes in a single head for departments, and, in fact, recommends the substitution of a single commissioner for the present three-man Conservation Commission.

Snoqualmie Tunnel to Be Opened for Service January 15

The Snoqualmie tunnel, recently built by the Chicago, Milwaukee & St. Paul Railway, will be put into regular service for the passage of trains Jan. 15. The excavation for both benches has been made, and those in charge expect to have the concrete lining of the tunnel fully completed throughout its length by Jan. 11. The tunnel is 2¼ mi. in length, passing through the Cascade Mountains about 40 mi. east of Seattle. The work was done entirely by company forces.

Reorganization of New York Utility Commissions Likely

Governor Whitman, of New York, who took office Jan. 1, favors an investigation into the management of the Public Service Commissions, with a view to such changes as may be demonstrated to be advisable. It is probable that the Legislature will take the initiative to have the investigation made, but if it does not it is certain that the governor will exercise his privilege of appointing a commissioner of his own selection to take up the investigation.

Annual Meeting of New England Waterworks Association

The New England Waterworks Association will hold its annual meeting at the Hotel Brunswick, Boston, Jan. 13. Following a luncheon at 1 p. m. Desmond Fitzgerald will show and describe a series of colored lantern slides of his travels. Reports by the officers of the society will be presented. The committee on filter statistics, consisting of Prof. George C. Whipple, chairman, Francis D. West, E. E. Lochridge, Robert Spurr Weston and Frank W. Green, will submit a report which will be discussed at a later meeting. The president will deliver his annual address and the tellers appointed to canvass ballots will report on the election of officers.

New York State Investigations to Start in Engineer's Department

Governor Whitman of New York has started the investigation into the conduct of the various State departments with the office of the State engineer and surveyor. In his inaugural address the governor promised that all departments would be looked into, not with the purpose of unearthing dishonest practices, but of furnishing data upon which to build up the departments on efficient lines.

Rivers and Harbors Bill

It is expected that Senator Burton will lead the fight again this year on the rivers and harbors "pork barrel." He has been named as a member of the subcommittee appointed to frame the measure for the Senate, but as all of the members supported the last bill there is doubt as to whether he will serve. The House bill carries about $35,000,000, but it is believed that the Senate will increase the amount.

Eugene W. Stern Appointed Chief Engineer of Highways

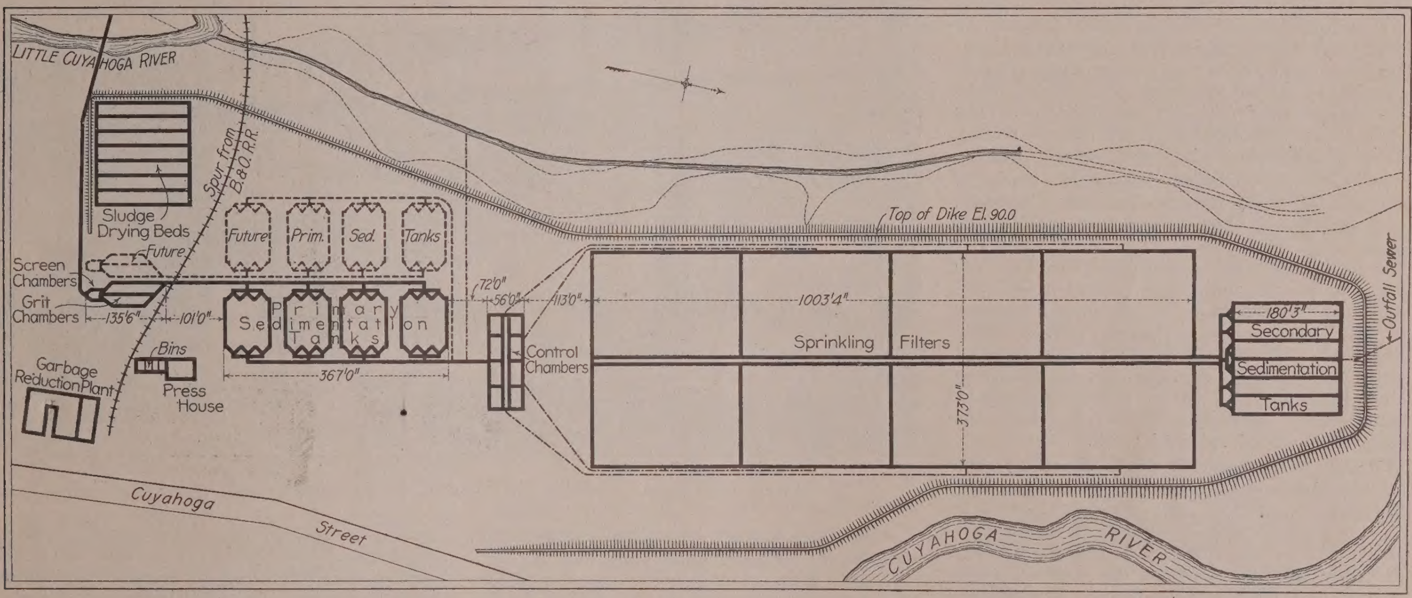
Eugene W. Stern, secretary of the American Institute of Consulting Engineers, has been appointed chief engineer of the Bureau of Highways, Borough of Manhattan, New York City, succeeding H. W. Durham, whose resignation will become effective Feb. 1. Mr. Durham has served as chief engineer since his appointment by Borough President McAneny on March 15, 1912. Mr. Stern is a graduate of the School of Practical Science, Toronto, and prior to opening an office in New York as consulting engineer was engaged in the design and construction of railroad and highway bridges in Kansas City and St. Louis.

Akron Is Building Sewage and Garbage Disposal Plants

New Features in the Design of Interdependent Works Located on Adjacent Sites—Sewage to Be Pressed—Double Effect Evaporators

The garbage reduction and sewage disposal plants, now fairly under way at Akron, Ohio, are located adjacent to each other on property purchased for the purpose 2½ mi. from the business center of the city on comparatively flat land in the Cuyahoga Valley west of Cuyahoga Street. The proposition to care for all of the city's wastes at one point was undertaken with the idea of disposing of the sewage sludge either by burning at the garbage plant or by utilizing as fertilizer.

As both plants for this growing city of 100,000 population are pioneers as to certain features, a brief description is given of each. The garbage plant will handle 25 tons per day and the sewage plant has a normal daily capacity of 15,000,000 gal.



RELATION OF GARBAGE REDUCTION PLANT TO SEWAGE TREATMENT WORKS UNDER CONSTRUCTION AT AKRON

Varying Velocity Grit Chambers

Taken in the sequence of sewage flow, the structures will consist of a main sewer extension, screen and grit chambers, reinforced-concrete flumes, primary sedimentation tanks, concrete control chambers, sprinkling filters, secondary sedimentation tanks, main outfall, sludge pump well, sludge tank chambers, sludge press house, sludge storage bins and sludge drying beds. After passing through the screen chambers the sewage will pass through the grit chambers, provision being made at these chambers for frequent cleaning and the removal of grit accumulations by means of an overhead tramway. By means of movable sides the flow of sewage through the grit chamber can be increased or decreased so that the grit only will be deposited.

Compressing the Sludge

The sludge accumulation in the lower compartments of the primary sedimentation tanks is removable by gravity flow into steel sludge tanks provided for it in the sludge tank chambers, and by the use of compressed air arrangement is made for forcing the sludge in any desired quantity to the main storage tank in the sludge press house.

Provision has been made for pumping the material deposited in the secondary sedimentation tanks to the sludge compartments of the primary sedimentation tanks.

The secondary process in the handling of sludge will consist of pressing and drying. The sludge press will receive the sludge in liquid form from the storage tanks and under pressure of air will remove a sufficient percentage of the water to permit of subsequent handling as cake.

Compressed air will lift the sludge from the storage tanks to the press. This press, actuated hydraulically, will discharge the partially dried sludge into a receiving hopper located beneath the press. The pressed sludge may be stored in concrete bins provided for the purpose, or may be conveyed to the garbage plant. Some of the sludge will be dried on the sludge drying beds to which it will be forced by compressed air.

Garbage Plant

The garbage plant consists of a boiler house, 105-ft. stack, green garbage room, where 50-ton cars entering on a trestle are unloaded by gravity, a building for unloading from teams, a conveyor tower to elevate the garbage to the five 5-ton digesters, rooms for disintegrator, percolators, grinders, screens and a gasoline storage building. Of special interest are the double effect evaporators which will have sufficient capacity to evaporate not less than 800 gal. of water per hour. The water, as delivered to the evaporator, will have a temperature of 100 deg. Fahr. and is to be evaporated from 3 to 24 Baumé with the use of steam at a pressure of 5 lb. per square inch. The stick-water will be mixed with the tankage. This unevaporated, heretofore wasted, liquor is the last product of a reduction plant to yield itself to commercial use.

Since drawing the original plans dutch ovens have been added to the proposed boiler equipment so that there may be double the ordinary grate surface for burning coal, city wastes or dried sludge.

Fireproof buildings of brick resting on concrete foundations will be provided with concrete roofs and steel sash fitted with wire glass.

The Kilby Manufacturing Company has the contract for the garbage equipment. J. C. Devine is building the structures and the trestle. E. McShaffrey & Sons have all of the sewage work except excavation and grading, which is being handled by the Duquesne Construction Company.

The work is being carried out under the general direction of J. H. Gehres, city engineer. R. Winthrop Pratt, consulting engineer of Cleveland, drew up the plans and has as his representative E. D. Barstow, to be engaged to supervise the work.

Personal Notes

Spiker & Greiner of Baltimore and Atlanta have been retained to design three concrete bridges at Rome, Ga.

Sidney Diamant, consulting engineer, New York City, has been retained as structural engineer for the new eight-story fireproof building for Frank Brothers to be erected at 588 Fifth Avenue, for which Alfred Freeman, New York City, is the architect.

Adolph F. Meyer, associate professor of hydraulics in the College of Engineering of the University of Minnesota has been engaged as consulting engineer for the International Joint Commission in connection with the investigations made on boundary waters between the United States and Canada.

R. D. Johnson, formerly hydraulic engineer of the Ontario Power Company of Niagara Falls, and P. Wahlman, formerly chief engineer of Compania Hidro-Electrica de Tucuman, Argentina, South America, have opened an office at 60 Wall Street, New York City, to engage in consulting hydraulic work.

J. B. Berry and S. S. Roberts, consulting civil engineers, of Chicago, have formed the firm of Berry & Roberts, to continue the general practice of civil engineering formerly carried out under the firm name of Berry, Howard & Roberts, which firm has been dissolved. They will make investigations, estimates and reports on all phases of railroad work.

Richard H. Aishton, vice-president of the Chicago & Northwestern Railway Company, has been appointed a member of the Federal industrial relations commission. President Wilson made the appointment to fill the vacancy on the commission caused by the appointment of Frederick A. Delano as a member of the Federal reserve board. Mr. Aishton, who lives in Evanston, Ill., has been connected with the Chicago & Northwestern Railway since 1878, when he started in the engineering department, subsequently working into the operating end of railroad work.

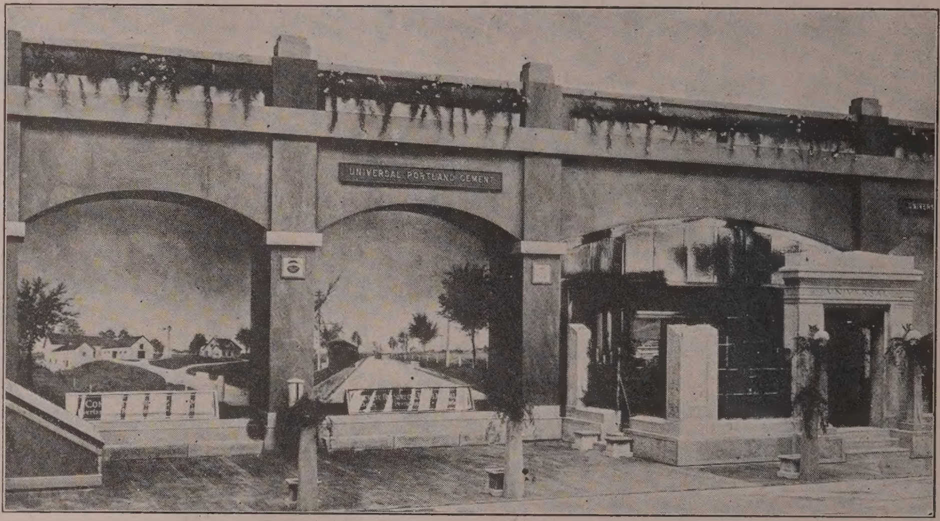
Hazen, Whipple & Fuller is the new name of the firm which was formerly Hazen & Whipple, consulting civil engineers, of New York City. Weston E. Fuller, whose name is added, has served with the firm for a number of years, devoting most of his time to water supply and filtration problems. Chester M. Everett, for eight years an employee of the firm, has been taken into partnership. This change was made Jan. 2, the twentieth anniversary of the foundation of the business. The firm name was first Noyes & Hazen, and continued thus far two years until Mr. Noyes's death. The business was then conducted under Mr. Hazen's name for seven years, since when the firm's name has been Hazen & Whipple.

H. W. Durham, after an incumbency of 3 years, has resigned his position as chief engineer of the bureau of highways, Borough of Manhattan, New York City. He was appointed to the position by former Borough President McAneny, coming from a 4½ years' service on the Cape Cod Canal, where he had been in charge of original surveys, then of the plans and finally of construction. Previous to that he had been in charge of municipal engineering on the Panama Canal Zone, employing at times as many as 1500 men. During his incumbency of the position he is now leaving, over one-fourth of the streets of Manhattan have been repaired at a cost of over $7,000,000. The bureau has been reorganized and standard specifications revised for the three chief types of pavement used in the borough, granite block, wood block and sheet asphalt. Three divisions have been created, each in charge of an engineer. The division of repaving has charge of contract work, while separate divisions look after the repairs, by day labor, to sheet asphalt and granite block surfaces. Within six months a municipal asphalt repair plant, which can take care of 3,000,000 sq. yd., now out of guarantee, was placed in service. By closer inspection and a system of records street openings are now more closely controlled, while all inspectors have been given careful training as to the meaning of specifications and their duties. Under Mayor Gaynor's administration Mr. Durham was sent to Europe and spent four months in studying European practice in thirty of the principal cities on the Continent and in England. As a result certain changes have been made in New York City's practice. Mr. Durham's resignation becomes effective Feb. 1 and until then no announcement of his plans will be made.

Cement Company's Exhibit at Exposition Ready

The Universal Portland Cement Company has completed the installation of its exhibit in the Palace of Mines and Metallurgy at the Panama-Pacific Exposition at San Francisco. The accompanying photograph shows its general appearance. Below a series of concrete arches are a number of oil paintings indicating how concrete may be used on the farm, for streets, factories and homes.

Under the central arch an electrically operated scenograph shows in miniature the operation of the company's factory at Pittsburgh. The buildings are electrically lighted, the machinery is in operation and carrying devices, cars, etc., are shown transferring material from various factory buildings, from the raw to the finished stock. Opposite this is another large cabinet showing schematically the various stages in the process of manufacture, the essential elements and the precautionary measures devised for safe-guarding the quality of the product and insuring an absolute standard.



PORTLAND CEMENT COMPANY'S EXHIBIT AT PANAMA-PACIFIC EXPOSITION

Cleveland's Electrically Controlled Traffic Signal

An illuminated electrically controlled traffic signal is now in operation in Cleveland. The device was installed at a street intersection by the American Traffic Signal Company, Aug. 5, 1914, and consists of eight high candlepower lights, four red and four green. These are installed on the right-hand side of the street, the red lights on the near side and the green across the street intersection. The red light means "stop" and the green one "proceed."

The device is operated by an officer in a booth at the corner, the booth being equipped with an emergency device so that the operating officer is in constant communication with the police and fire departments, the fire alarms being repeated in the booth at the same time they are received in the stations. If the fire-fighting apparatus is to pass the corner where the signal is located traffic in all directions can be closed by the signal. In addition a gong is sounded which warns all drivers to draw up at the curb. The colored lights can be seen in the daytime as well as at night, and can be discerned readily at a distance of several blocks.

Executive Committee's Report to Cement Manufacturers

The report of the executive committee to the Association of American Portland Cement Manufacturers, presented at its annual meeting in New York, Dec. 9, has just been made public. It shows that the total membership of the association at present includes seventy companies.

Of special interest in the report is the description of the widespread inspection work undertaken by the association in order to insure proper execution of concrete road work. The necessity for educational campaigns to show railroad and municipal engineers the possibilities of concrete in their work is rather surprising. One would expect with the varied uses of concrete that all engineers would be fully awake to its possibilities.

Bearing upon the recent progress of the cement industry and the immediate future, the following quotations are of interest:

"The cement industry in this country has had phenomenal expansion. Even in times of financial depression we have had an increase in consumption. During the last few years large uses, such as are exemplified in railway and building construction, have been very materially curtailed. A glance at the increase in the number of small sales will clearly demonstrate this. Such increase is due to the general popularizing of concrete construction, brought about by the educational publicity campaigns carried on by the association and several of our individual companies. We are reaping to-day the benefit of farm campaigns started in 1910. Had it not been for our road campaign, started in 1911, the consumption of cement would certainly show a decrease over previous years. . . . .

"It is unnecessary to remind you that there has been a gradual slackening in the demand for cement since the outbreak of the European war, and as the season for construction is rapidly drawing to a close, we cannot hope for any change this year.

"The outlook for next year is, however, by no means hopeless. While business may remain somewhat quiet, there are many signs of improvement. The country has been exercising such economy as has not been known for many years, and is for this reason in a comparatively healthy condition. . . . .

"The inability of Germany and Belgium to export cement should enable us to largely increase our trade with South and Central America."